ENERGY AUDIT OF

BLANCHFIELD ARMY COMMUNITY HOSPITAL

FORT CAMPBELL, KENTUCKY

FINAL REPORT

VOLUME 1 OF 3 : EXECUTIVE SUMMARY

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1. INTRODUCTION

The purpose of this project is to perform a detailed energy audit and engineering analysis of the Blanchfield Army Community Hospital, three dental clinics and five troop medical clinics located at Fort Campbell Kentucky. The audit was performed to gather information which was used to evaluate the energy conservation opportunities listed in the scope of work as well as to identify other possible energy conservation opportunities. After evaluating all ECO's and listing in order of highest to lowest savings to investment ratio (SIR), I. C. Thomasson worked with Base Master Planning, DEH, and Utility Personnel to develop energy conservation projects by grouping the ECO's into appropriate packages. Project documentation was then prepared in accordance with the scope of work. A comprehensive report was prepared to document the work accomplished. This document summarizes the contents of this report and is contained in the final report.

The facilities which were included in this project are shown in Table 1-1:

Table 1-1: Buildings Included in the Scope of Work

Hospital Complex:

Bldg. No.	Name	Function
650	A	Patient Tower
650	B	Surgery, ICU, Store, etc.
650	C	Outpatient Services
650	D	Power House

Dental Clinics:

Bldg. No.	Name	Function
3603	Epperly	Dental Clinic
5580	Taylor	Dental Clinic
5980	Kuhn	Dental Clinic

Troop Medical Clinics:

Bldg. No.	Name	Function
3968	TMC #7	Troop Medical Clinic
6139	TMC #4	Troop Medical Clinic
6714	TMC #2	Troop Medical Clinic
6903	TMC #3	Troop Medical Clinic
7166	TMC #5	Troop Medical Clinic

1. INTRODUCTION

These buildings represent a total of approximately 480,000 square feet of space and a total energy consumption of approximately 161,325 million BTU/yr.

The projects which have been developed as a result of the analysis have a potential of conserving 66,608.9 million BTU/yr of site energy at an annual energy cost savings of $633,867 at a capital investment of approximately $2,272,089. The simple payback period for these projects is 3.66 years.

2. BUILDING DATA

The scope of work included a total of 12 buildings. These are four buildings which, together, form the Hospital Complex, three dental clinics, and five troop medical clinics (TMC's). The hospital buildings were all designed and constructed in a single project with construction being basically complete in 1982. Two of the dental clinics are duplicate structures with one being completed in 1974 (Taylor) and the other in 1977 (Epperly). The third dental clinic was completed in 1962 (Kuhn). Table 2-1 is a detailed listing of building data.

In establishing the importance of these facilities from a remaining life point of view, we have developed a statistic called Useful Life Remaining which has units of "person-hours." This value is calculated by multiplying the average building occupancy by the number hours the building is occupied per year and then by the remaining life expectancy in years for the building. The buildings included in this project represent a potential for 271.5 million person-hours of occupancy over their life. This is an average annual rate of 10,860,160 person hours.

If we divide the annual energy cost savings by the average annual number of person-hours, a savings of $0.058 is achieved for every hour of occupancy by every person in these facilities each year. Likewise, calculating the energy saved, we obtain a value of 6,133.3 BTU for each person-hour of occupancy on an annual basis. Using an occupancy life of 25 years at 365 days/yr and 24 hrs per day, a savings of 7,603,756 BTU/hr is obtained. This is enough energy to run a 3,000 HP electric motor fully loaded continuously for 25 years.

The relative square footage of the buildings is illustrated in Figure 2-1. Figure 2-2 shows the number of person-hours predicted for the remaining building life. The pie charts in Figure 2-3 and Figure 2-4 show the percentage of total project square footage for each group of buildings and percentage of total person-hours for each group of buildings respectively. Note that Figures 2-1 and 2-2 use log scales for the vertical axis. While this dramatically reduces the visual impact of the order of magnitude differences in the values in the graphs, a linear scale would not be readable.

The pie charts more graphically show the order of magnitude differences in both square footage and useful remaining life in person-hours.

TABLE 2-1: BUILDING DATA

BLDG NO.	NAME	FUNCTION	AREA SQ.FT.	YEAR CONSTRUCTED	CONDITION	EXPECTED REMAINING LIFE (YRS)	AVERAGE OCCUPANCY PEOPLE	DAILY OPERATING HOURS	DAYS/WK.	USEFUL LIFE REMAINING PERSON HRS X 1000
HOSPITAL COMPLEX:										
650 A	Building A	Patient Tower	136,780	1982	Good	25	400	24	7	87,600
650 B	Building B	Surgery,ICU,Stores,etc.	173,760	1982	Good	25	580	24	7	127,020
650 C	Building C	Outpatient Services	92,900	1982	Good	25	400	12	5	43,800
650 D	Building D	Powerhouse	10,900	1982	Good	25	10	24	7	2,190
			414,340				1,390			260,610
DENTAL CLINICS:										
3603	Epperly	Dental Clinic	15,404	1977	Fair	10	112	10	5	2,912
5580	Taylor	Dental Clinic	14,015	1974	Fair	10	105	10	5	2,730
5980	Kuhn	Dental Clinic	10,400	1962	Fair	10	68	10	5	1,768
			39,819				285			7,410
TROOP MEDICAL CLINICS:										
6714	TMC#2	Troop Medical Clinic	3,321	1956	Fair	10	23	10	5	598
6903	TMC#3	Troop Medical Clinic	3,321	1956	Fair	10	23	10	5	598
6139	TMC#4	Troop Medical Clinic	3,321	1956	Fair	10	23	10	5	598
7166	TMC#5	Troop Medical Clinic	7,810	1972	Fair	10	45	10	5	1,170
3968	TMC#7	Troop Medical Clinic	3,551	1974	Fair	10	20	10	5	520
			21,324				134			3,484
		Total:	475,483			Total:	1,809		Total:	271,504

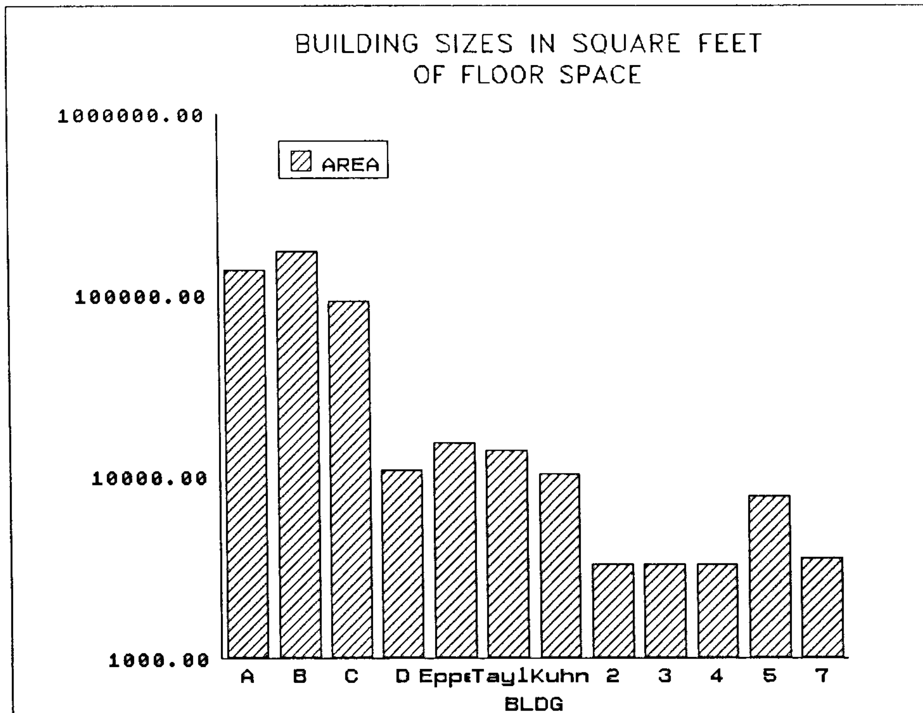


Figure 2-1

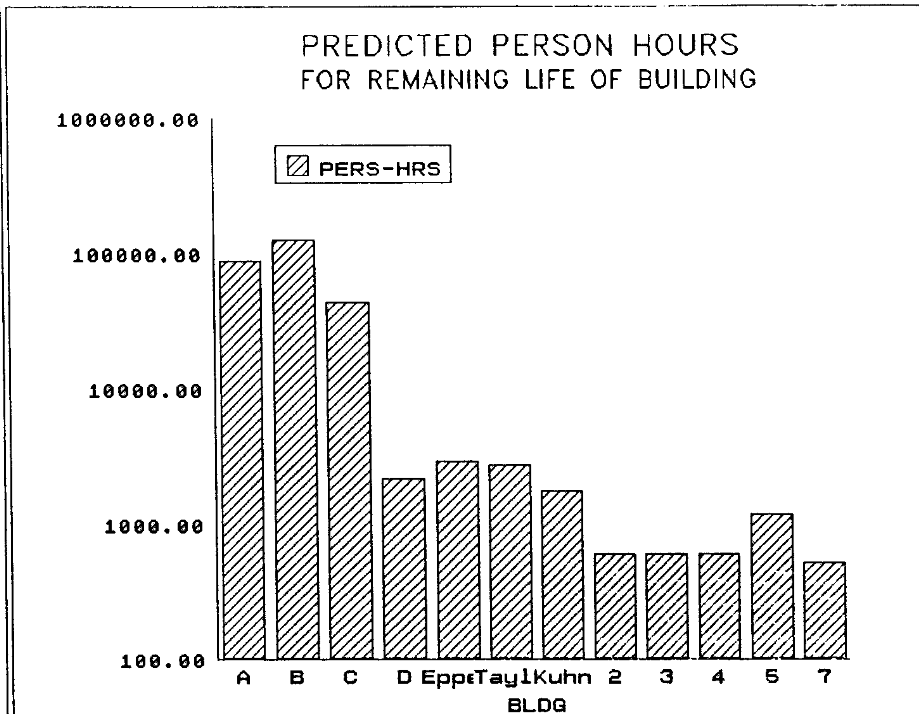


Figure 2-2

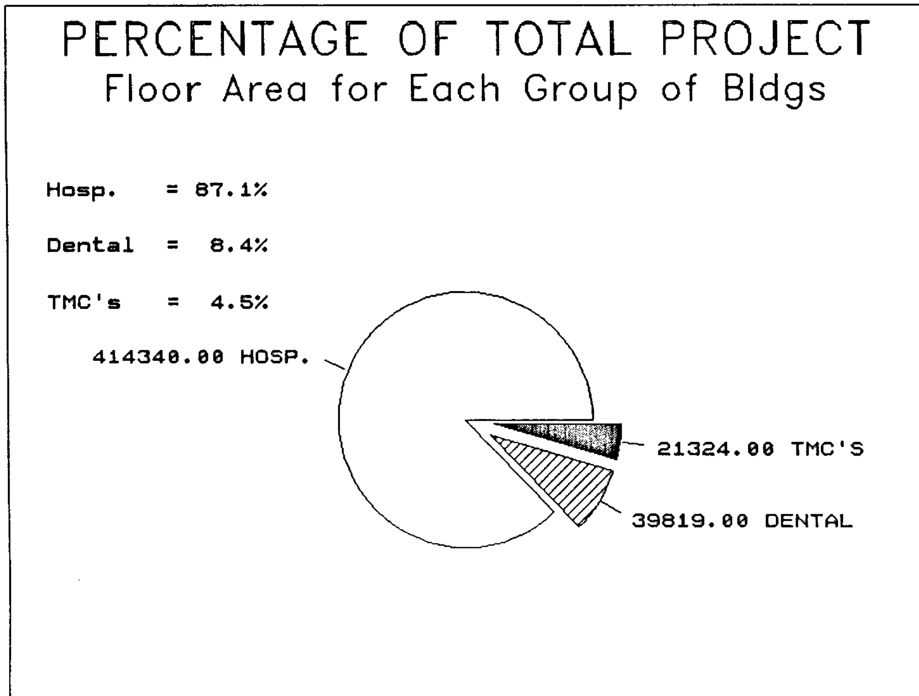


Figure 2-

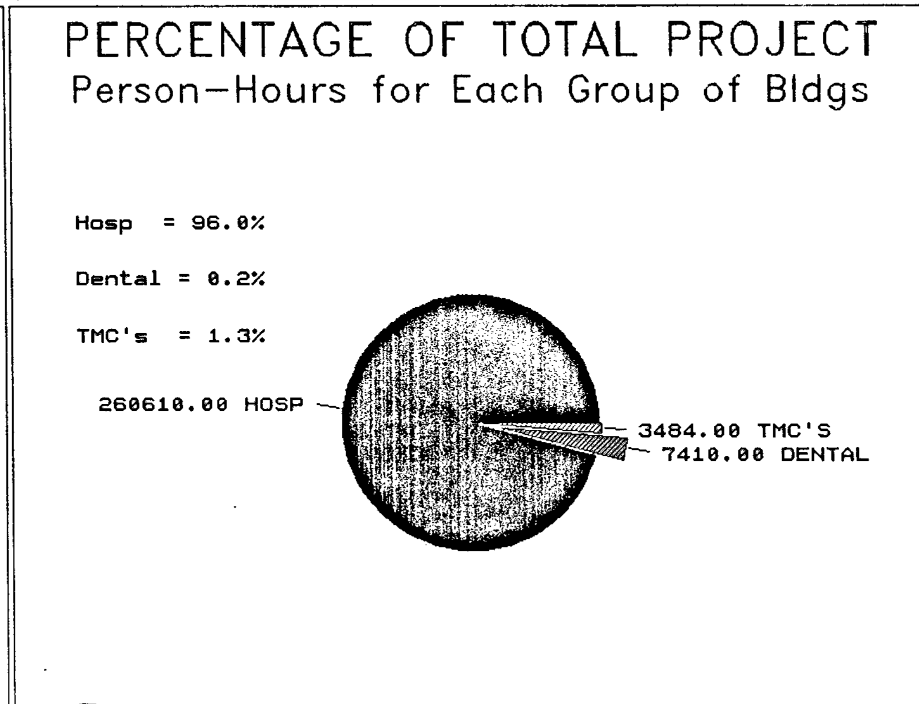


Figure 2-4

3. PRESENT ENERGY CONSUMPTION

3.1 Total Annual Energy Used

Present energy consumption for each of the buildings was determined by modeling on the BLAST Program for the Hospital, and on the BRUTE Program for the remaining buildings. The models were developed based on information obtained in the field during the survey of the buildings and from copies of "as built" or Record Drawings. There was historical data available only for the Hospital Complex against which it was possible to calibrate the model. The results of the energy consumption obtained from the model were used as the value for present energy consumption. Table 3-1 gives the present energy use in millions of BTU per year obtained from the models.

Table 3-1: Total Annual Energy Used (By Buildings in Millions of BTU)

Hospital Complex (Refer to Figure 3-1):

Bldg. No.	Name	Energy Used
650	A	48,180.9
650	B	89,337.0
650	C	10,468.6
	Total	147,986.5

Note: Energy consumption for Building D (Power House) is included in A, B, & C).

Dental Clinics (Refer to Figure 3-2):

Bldg. No.	Name	Energy Used
3603	Epperly	2,625.9
5580	Taylor	5,309.9
5980	Kuhn	3,434.4
	Total	11,370.2

Troop Medical Clinics (Refer to Figure 3-3):

Bldg. No.	Name	Energy Used
6714	TMC#2	272.7
6903	TMC#3	272.7
6139	TMC#4	272.7
7166	TMC#5	708.8
3968	TMC#7	441.2
	Total	1,968.1

TOTAL FOR EEAP PROJECT (Refer to Figure 3-4) = 161,324.8 Million BTU/yr

Figure 3-1 through Figure 3-3 show a pie chart of the present site energy use for the Hospital Complex, Dental Clinics, and Troop Medical Clinics respectively. Figure 3-4 shows total site energy use for each group of buildings. Note that the Hospital uses over 92% of the site energy used by all of the buildings. To totally eliminate the energy used by the eight other buildings would represent saving less than 10% of the energy used by the Hospital.

Figure 3-1 indicates that among the hospital complex buildings, Building B contains the greatest opportunity for implementing energy conserving measures. Building A is a close second to Building B, with Building C providing relatively little opportunity for improvement.

Among the Dental Clinics (Figure 3-2), Taylor and Kuhn appear to have the greatest opportunities. However, due to the age of Kuhn and the need for a major renovation project, no projects were developed for the building. The significance of the heat recovery coil loop installed in Epperly at the time of construction in 1977 is clearly indicated in the pie chart. Epperly and Taylor are effectively duplicate buildings, and yet the energy consumption in Epperly is roughly half that of Taylor.

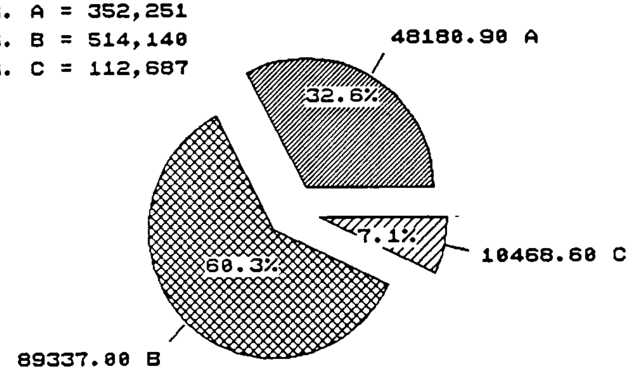
As a whole the Troop Medical Clinics provide little opportunity for energy conservation. This is due to the relatively short (office business hours) occupancy periods, lack of substantial individual zoning via reheat or dual duct (TMC's 2, 3 and 4) and low energy intensity of function.

As with the graphical representation of the building data in the previous section, the graphical representation of annual energy consumption by building group again indicates that the Dental Clinics and TMC's are low in energy conservation potential.

HOSPITAL COMPLEX TOTAL SITE ENERGY MILLIONS OF BTU'S

ENERGY INDEX (BTU/SF YR)

BLDG. A = 352,251
BLDG. B = 514,140
BLDG. C = 112,687



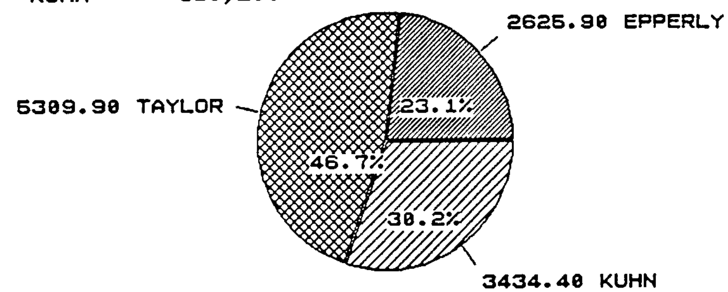
TOTAL SITE ENERGY = 153456.1

Figure 3-1

DENTAL CLINICS TOTAL SITE ENERGY MILLIONS OF BTU'S

ENERGY INDEX (BTU/SF YR)

EPPERLY = 132,889
TAYLOR = 380,707
KUHN = 330,200



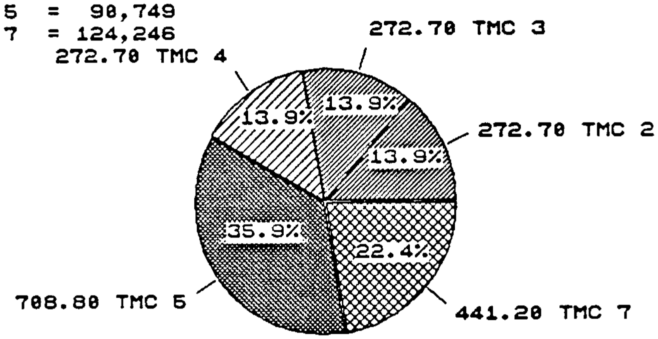
TOTAL SITE ENERGY = 11370.2

Figure 3-2

TROOP MEDICAL CLINICS TOTAL SITE ENERGY MILLIONS OF BTU'S

ENERGY INDEX (BTU/SF YR)

TMC 2 = 82,113
TMC 3 = 82,113
TMC 4 = 82,113
TMC 5 = 90,749
TMC 7 = 124,246



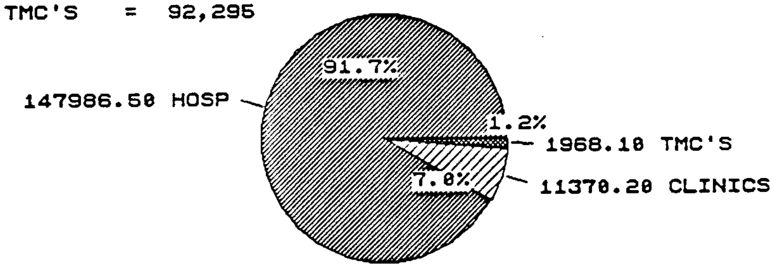
TOTAL SITE ENERGY = 1968.1

Figure 3-3

PROJECT TOTAL SITE ENERGY MILLIONS OF BTU'S

ENERGY INDEX (BTU/SF YR)

HOSPITAL = 380,369
CLINICS = 285,547
TMC'S = 92,295



TOTAL SITE ENERGY = 161324.8

Figure 3-4

3.2 Source Energy Consumption By Energy Type

Source energy consumption was determined from the BLAST output reports and using the DOE conversion factor for converting site electric energy to source energy. this factor is 3.39 times the site energy, or 11,600 BTU/kwh. Table 3-2 shows the source energy for each building by energy type. This data has been graphed (Figure 3-5) on a log scale for easier reading. Approximately 69% of the total source energy used is electric energy (Figure 3-6). Therefore, the more direct use of energy in the form of primary fuel is more energy conserving than the conversion of that fuel to electric energy. From a source point of view, the energy used for cooling, fans, pumps, lights, etc., is much more significant than the site energy figures indicate.

TABLE 3-2: SOURCE ENERGY CONSUMPTION BY TYPE

COMPONENT	BUILDING	ELECTRICITY CONSUMPTION (KWH)	ELECTRICITY COST ($)	ELECTRICITY MBTU	FUEL OIL CONSUMPTION (GAL.)	FUEL OIL COST ($)	FUEL OIL MBTU	NATURAL GAS CONSUMPTION (THERMS)	NATURAL GAS COST ($)	NATURAL GAS MBTU	TOTALS COST($)	TOTALS MBTU
	650A	5,126,839	$267,399.42	59,471	204,963	$175,640.99	30,683	0	0	0	$443,040.41	90,154
	650B	9,620,275	501,762.59	111,595	377,442	323,444.34	56,503	0	0	0	825,206.93	168,098
Blanchfield Hospital	650C	2,150,601	112,168.43	24,947	20,902	17,911.57	3,129	0	0	0	130,080.00	28,076
	Subtotal	16,897,715	$881,330.44	196,013	603,307	$516,996.90	90,315	0	0	0	$1,398,327.34	286,328
	3603(Epperly)	383,123	19,982.48	4,444	0	0	0	13,183	6,504.62	1,318	26,487.10	5,762
	5580(Taylor)	732,347	38,196.86	8,495	0	0	0	28,104	13,866.79	2,810	52,063.65	11,305
Dental Clinics	5980(Kuhn)	339,672	17,716.91	3,940	0	0	0	22,751	11,225.57	2,275	28,942.48	6,215
	Subtotal	1,455,142	$75,896.25	16,879	0	0	0	64,038	$31,596.98	6,403	$107,493.23	23,282
	6714(TMC#2)	48,550	2532.19	563	0	0	0	1,107	546.20	111	3,078.39	674
	6903(TMC#3)	48,550	2532.19	563	0	0	0	1,107	546.20	111	3,078.39	674
Troop	6139(TMC#4)	48,550	2532.19	563	0	0	0	1,107	546.20	111	3,078.39	674
Medical Clinics	7166(TMC#5)	108,321	5649.68	1,257	0	0	0	3,391	1,673.15	339	7,322.83	1,596
	3968(TMC#7)	58,424	3047.19	678	0	0	0	2,418	1,193.07	242	4,240.26	920
	Subtotal	312,395	$16,293.44	3,624	0	0	0	9,130	$4,504.82	914	20,798	4,538
TOTAL		18,665,252	$973,520.13	216,516	603,307	$516,996.90	90,315	73,168	$36,101.80	7,317	$1,526,618.83	314,148

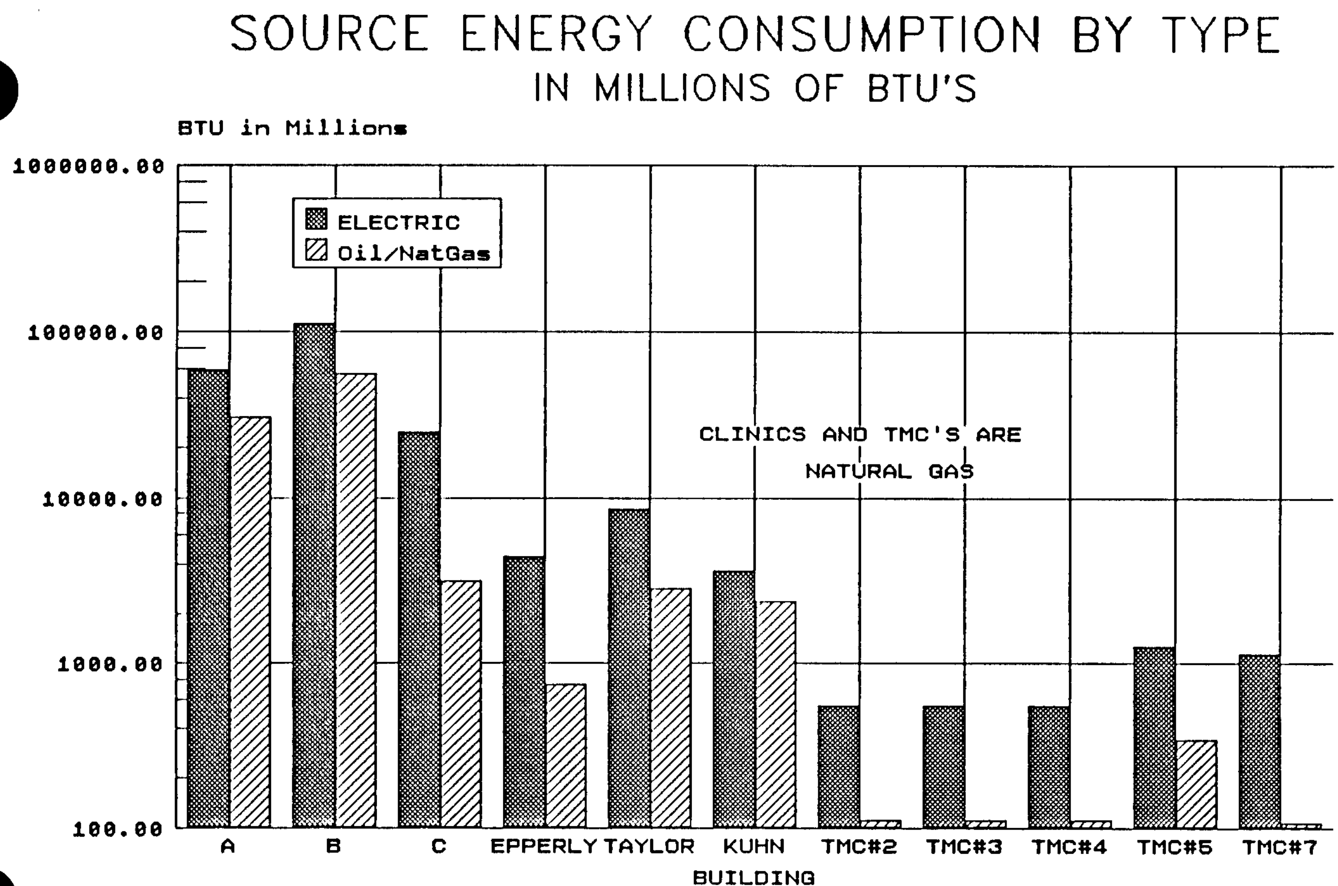
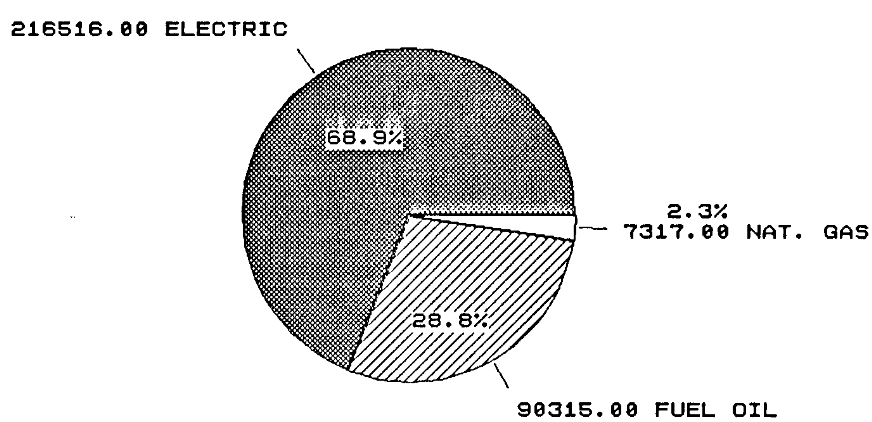


Figure 3-5

TOTAL PROJECT SOURCE ENERGY BY TYPE

MILLIONS OF BTU'S



TOTAL PROJECT SOURCE ENERGY = 314148 MBTU

Figure 3-6

3.3 Energy Consumption By Systems

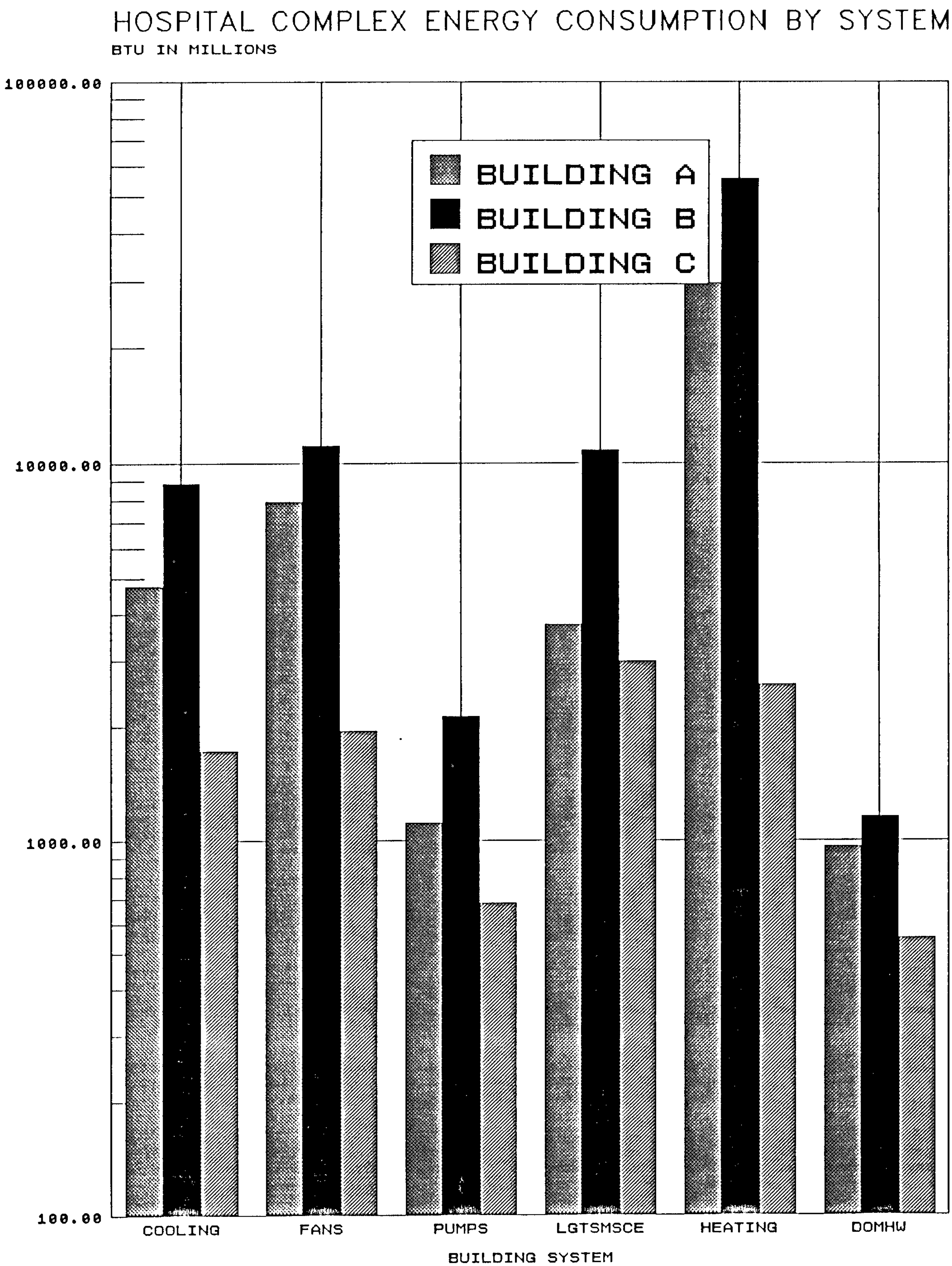
Data has been extracted from the computer generated models to show the energy consumption by building systems. These include heating, cooling, fans, pumps, lights and miscellaneous equipment, and domestic water heating. Table 3-3 gives these values for each building included in the study. The largest single use of energy is for heating. This is true for all of the buildings except for Building C of the Hospital Complex. The heating energy value includes energy used for reheat. Because of the type of systems in these facilities, constant volume reheat and dual duct -- except for Building C (VAVshutoff with no reheat and inadequate perimeter heating) -- large amounts of energy are used to transfer cooled media to the load (fan and pump energy) and then to neutralize the cooled media by reheating it or mixing it with heated media. Conversion of these systems to appropriately designed VAVsystems and variable water flow systems will significantly change these values on a percentage basis.

Figures 3-7, 3-8, and 3-9 give the energy consumption by system for the Hospital Complex, Dental Clinics, and Troop Medical Clinics respectively by building. Note that a log scale was used to make the graphs more readable. The total site energy by system is shown in pie chart form in Figures 3-10, 3-11, and 3-12. The Troop Medical Clinics are the only group where the heating energy drops below 50% of the total. Figure 3-13 shows the distribution of energy consumption between the various systems for the total project. Again, heating energy, including reheat, represents 58% of the total site energy.

The energy use distribution among the systems indicates that the hospital complex cooling system is lightly loaded for the largest percentage of the time. This was also indicated in our field survey work. Conversion to the systems which have been developed in the projects resulting from this EEAP project will allow them to respond by using less energy instead of more energy as they currently do.

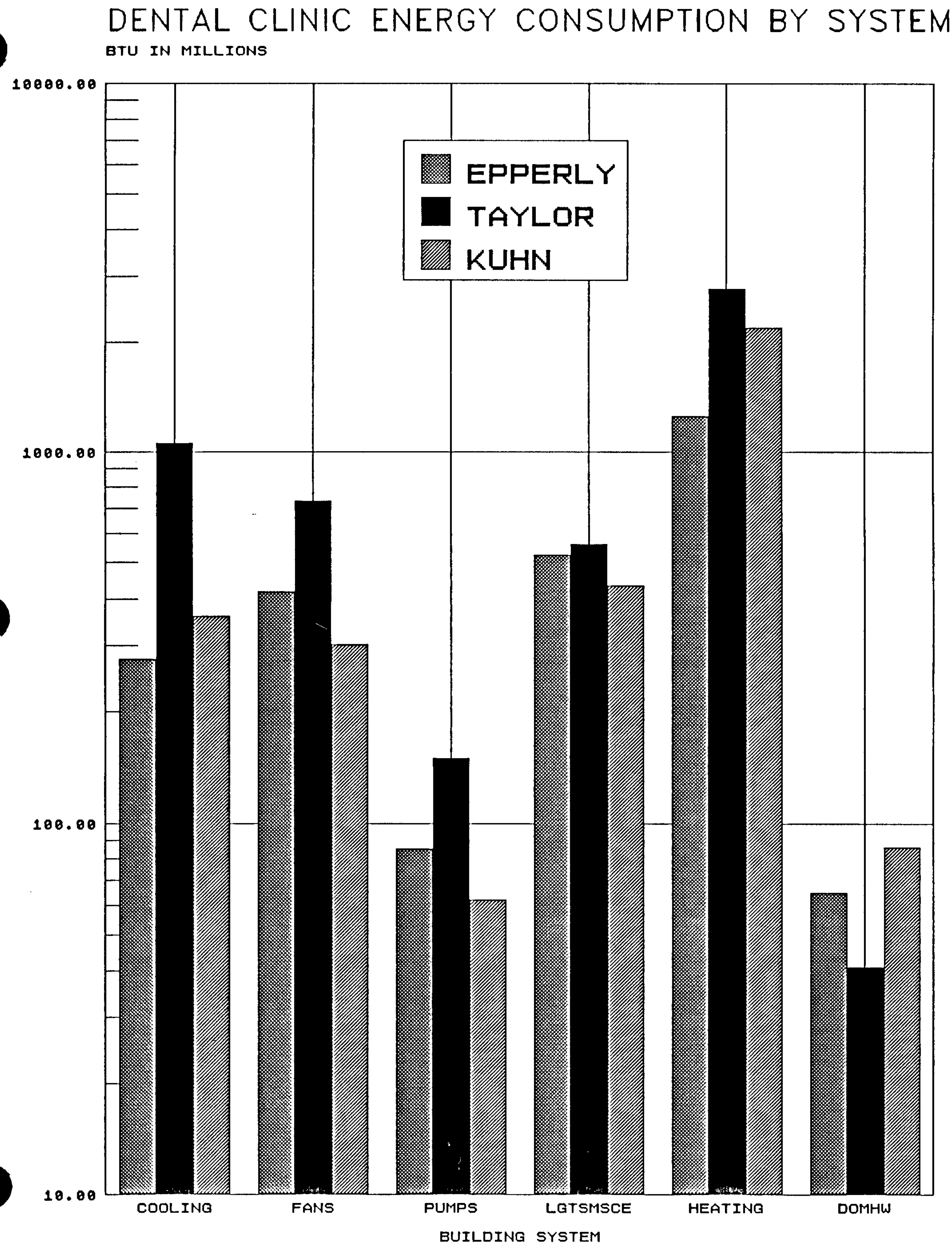
Table 3-3 Site Annual Energy Consumption by Systems and Building (BTU in Millions

Building	Cooling	Fans	Pumps	Lights and Misc. Equip.	Heating	Wtr. Hea	Total
A	4,748.0	7,902.5	1,105.7	3,741.7	29,725.7	957.3	48,180.9
B	8,836.6	11,104.6	2,128.4	10,764.4	55,351.3	1,151.7	89,337.0
C	1,727.5	1,953.4	681.2	2,977.9	2,580.6	548.0	10,468.6
Hosp. Complex	15,312.1	20,960.5	3,915.3	17,484.0	87,657.6	2,657.0	147,986.5
3603 (Epperly)	277.1	467.6	36.8	526.1	1,253.4	64.9	2,625.9
5580 (Taylor)	1,059.6	778.6	99.3	562.0	2,769.5	40.9	5,309.9
5980 (Kuhn)	360.3	302.3	61.9	434.8	2,189.1	86.0	3,434.4
Dental Clinics	1,697.0	1,548.5	198.0	1,522.9	6,212.0	191.8	11,370.2
6714 (TMC 2)	46.3	53.1	10.9	55.4	101.0	6.0	272.7
6903 (TMC 3)	46.3	53.1	10.9	55.4	101.0	6.0	272.7
6139 (TMC 4)	46.3	53.1	10.9	55.4	101.0	6.0	272.7
7166 (TMC 5)	91.6	61.1	12.5	204.5	314.3	24.8	708.8
3968 (TMC 7)	37.8	72.6	14.9	74.1	219.2	22.6	441.2
TMC's	268.3	293.0	60.1	444.8	836.5	65.4	1,968.1
Total Project	17,277.4	22,802.0	4,173.4	19,451.7	94,706.1	2,914.2	161,324.8



HOSPITAL COMPLEX ENERGY CONSUMPTION BY SYSTEM
BTU IN MILLIONS
100000.00
10000.00
1000.00
100.00
BUILDING A
BUILDING B
BUILDING C
COOLING
FANS
PUMPS
LGTSMSCE
HEATING
DOMHW
BUILDING SYSTEM

Figure 3-7



DENTAL CLINIC ENERGY CONSUMPTION BY SYSTEM
BTU IN MILLIONS
10000.00
1000.00
100.00
10.00
EPPERLY
TAYLOR
KUHN
COOLING
FANS
PUMPS
LGTSMSCE
HEATING
DOMHW
BUILDING SYSTEM

Figure 3-8

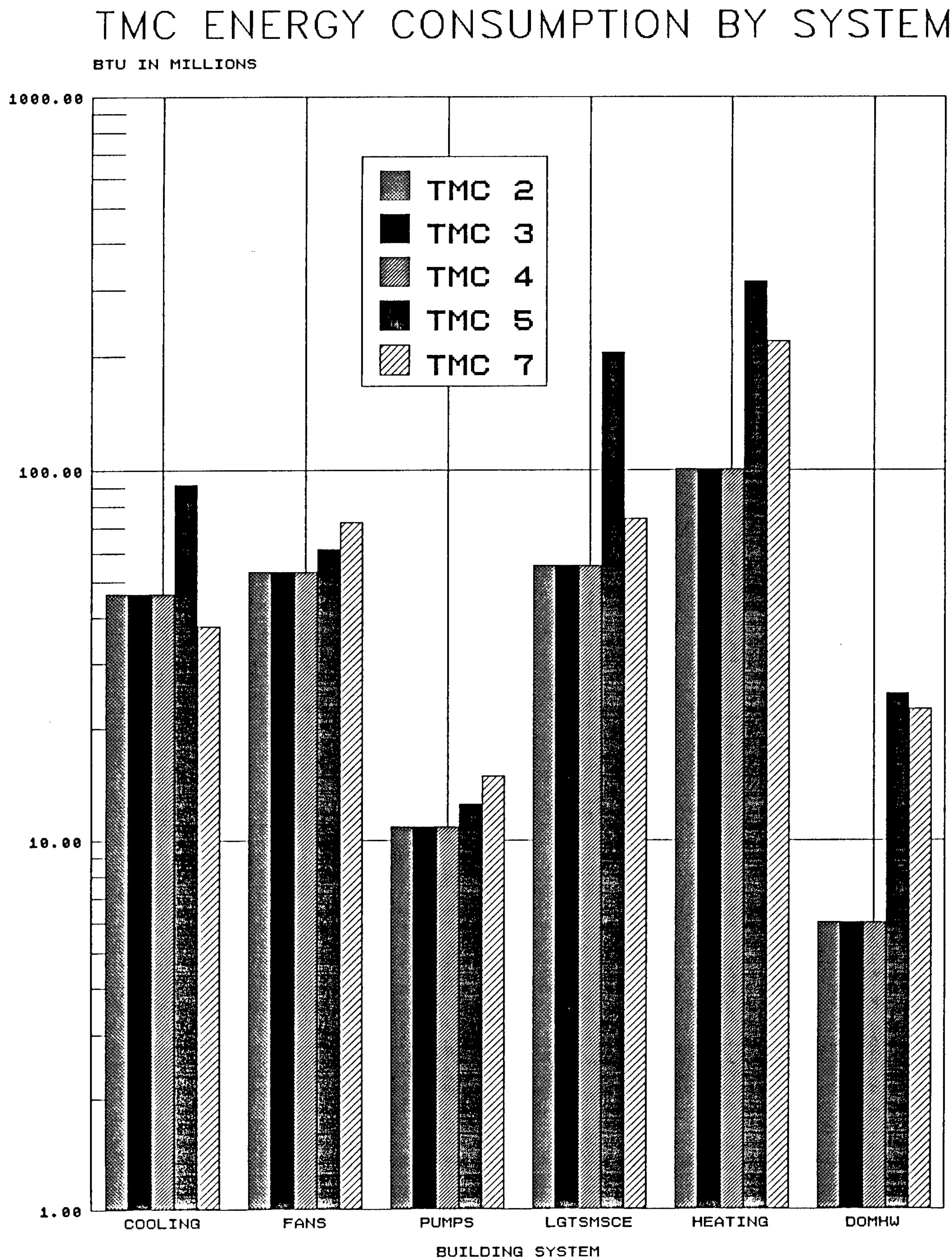
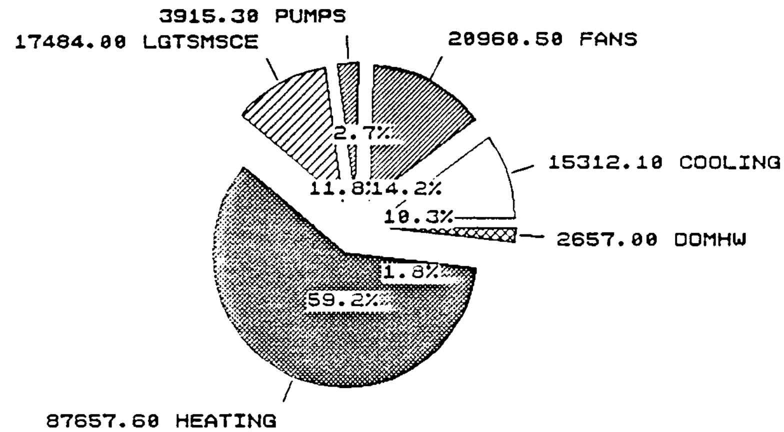

TMC ENERGY CONSUMPTION BY SYSTEM
BTU IN MILLIONS
1000.00
100.00
10.00
1.00
TMC 2
TMC 3
TMC 4
TMC 5
TMC 7
COOLING
FANS
PUMPS
LGTSMSCE
HEATING
DOMHW
BUILDING SYSTEM

Figure 3-9

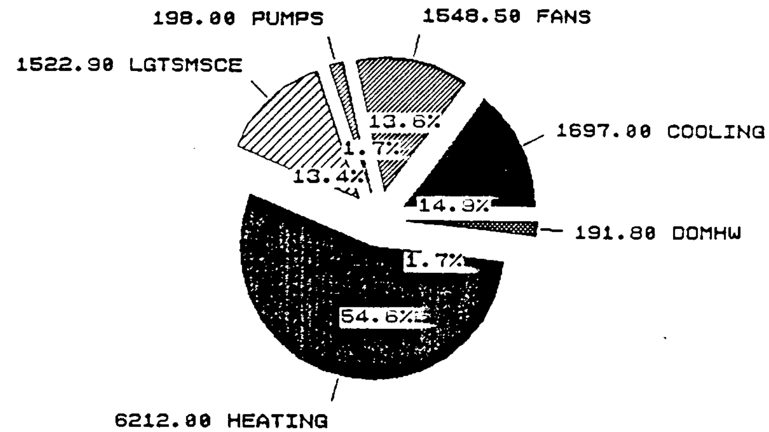
HOSPITAL COMPLEX ENERGY CONSUMPTION
BY SYSTEM - MILLIONS OF BTU



TOTAL = 147,986.5

Figure 3-10

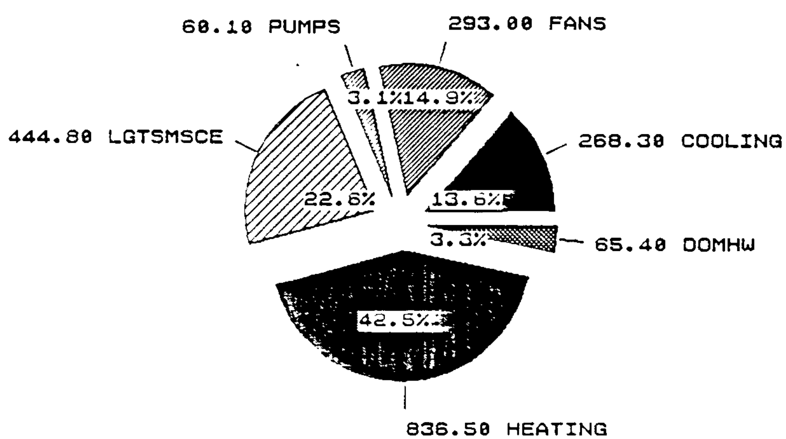
DENTAL CLINICS ENERGY CONSUMPTION BY S[illegible]EM
MILLIONS OF BTU



TOTAL = 11370.2

Figure 3-11

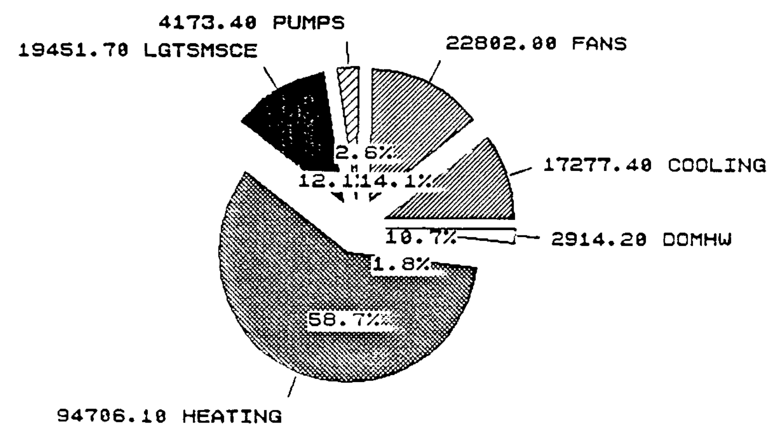
TROOP MEDICAL CLINICS CONSUMPTION BY SYSTEM
MILLIONS OF BTU



TOTAL = 1968.1

Figure 3-12

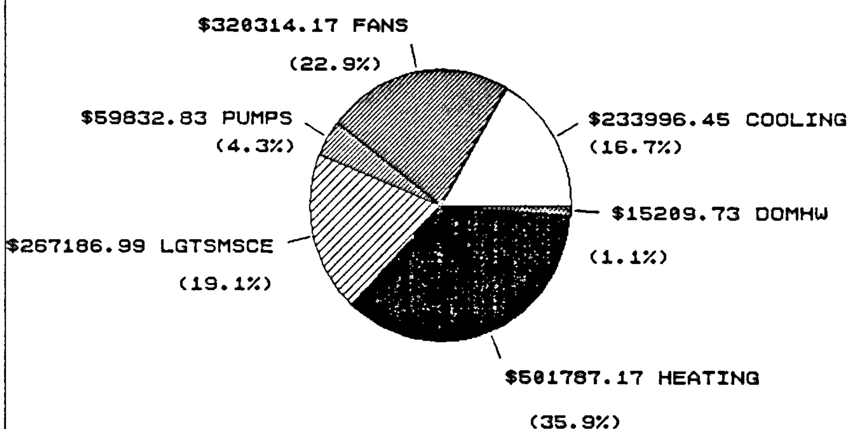
TOTAL SITE ENERGY CONSUMPTION BY SYSTEM
MILLIONS OF BTU



TOTAL = 161,324.8

FIGURE 3-13

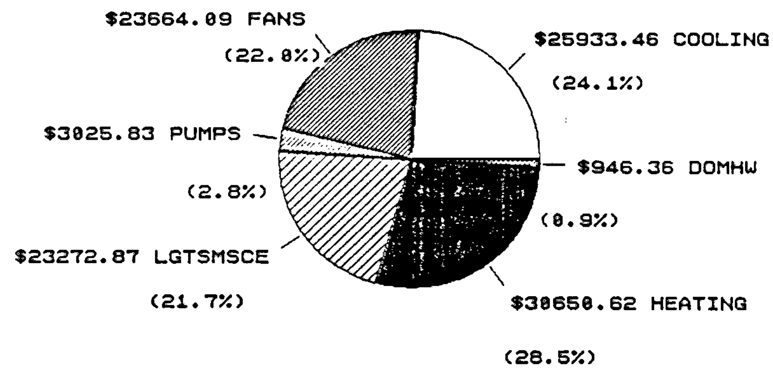
HOSPITAL COMPLEX ENERGY COST BY SYSTEM



TOTAL = $1,398,327.34

FIGURE 3-14

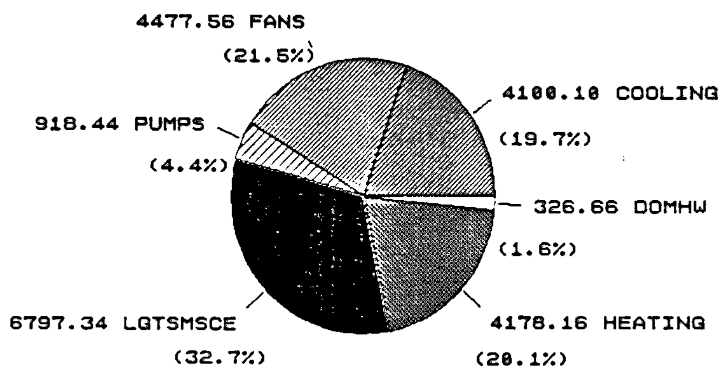
DENTAL CLINICS ENERGY COST BY SYSTEM
DOLLAR COST



TOTAL = $107,493.23

FIGURE 3-15

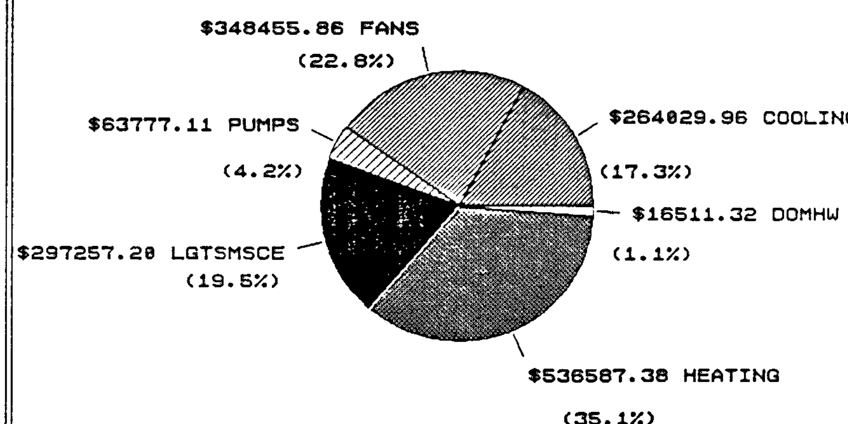
TROOP MEDICAL CLINICS ENERGY COST BY SYSTEM



TOTAL = $20,798.26

FIGURE 3-16

TOTAL SITE ENERGY COST BY SYSTEM



TOTAL = $1,526,618.83

FIGURE 3-17

4. HISTORICAL ENERGY CONSUMPTION

Historical Energy Consumption Data was available only for the Hospital Complex. None of the other eight buildings included in the study are individually metered for electric energy or natural gas. However, data was available from fuel oil meter records and electric submeter readings for the Hospital Complex. This data was obtained from the Directorate of Engineering and Housing at Fort Campbell, Kentucky. This data was used to calibrate the base run of the BLAST Simulation for the Hospital Complex. Refer to Table 4-1 below.

Table 4-1: Annual Energy Consumption BACH Comparison MBTU/Yr.

	Electricity	Fuel Oil
BLAST Modeled Consumption	57,672	90,315
Historical Consumption	60,981	84,391
	-3,309	5,924
Deviation	(-5.4%)	(7.0%)

This comparison indicates that the BLAST Model which was developed for the Hospital Complex is reasonably accurate and that the model is low on electric energy use estimates (5.4% low) and high on the fuel oil use estimate (7%). From this it may be possible to assume our energy savings estimate in fuel oil may be high. However, this is not necessarily the case since modifications have been made to the heating system at the Hospital which would increase the actual heating energy use. Figure 4-1 shows the actual annual energy consumption compared to the BLAST model.

In order to evaluate the significance of the energy consumption patterns in the historical data for the Hospital Complex, two types of graphs were made for the data. The first graph (refer to Figure 4-2) shows the energy consumption by type for each month of FY84 and FY85 and for part of FY86. Notice that the electric energy consumption is stable around 5,000 million BTU/month. This is indicative of the relatively large amounts of electric energy used in constant loads, such as lights and miscellaneous equipment, and heat transfer media transport (fans and pumps) when compared to the relatively small amounts of energy used for actual cooling. This data is consistent with the large energy savings that are obtained by utilizing variable volume air and water flow systems.

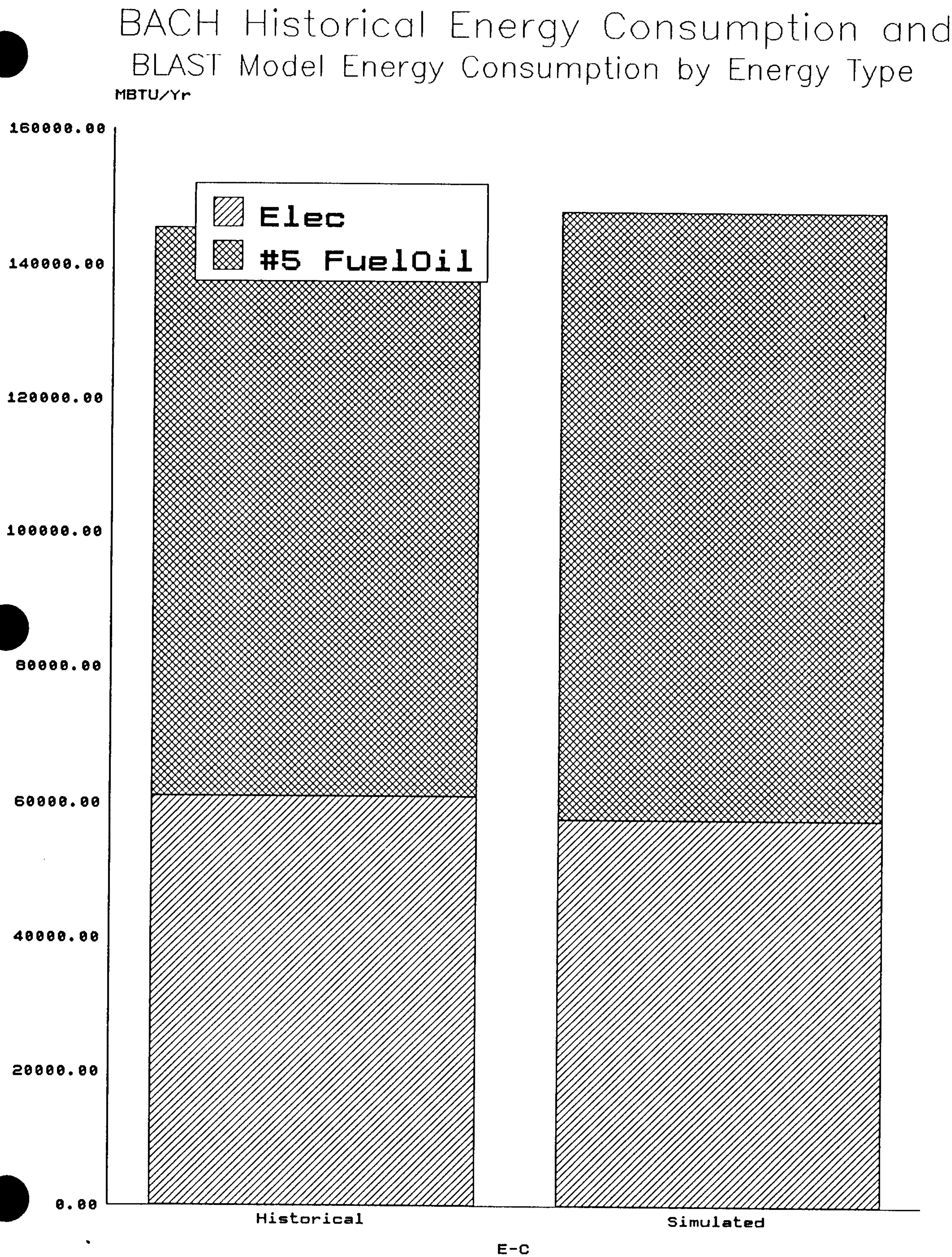

BACH Historical Energy Consumption and
BLAST Model Energy Consumption by Energy Type
MBTU/Yr
160000.00
140000.00
120000.00
100000.00
80000.00
60000.00
40000.00
20000.00
0.00
Elec
#5 FuelOil
Historical
Simulated
E-C

Figure 4-1

BACH ENERGY CONSUMPTION HISTORY

BTU IN MILLIONS

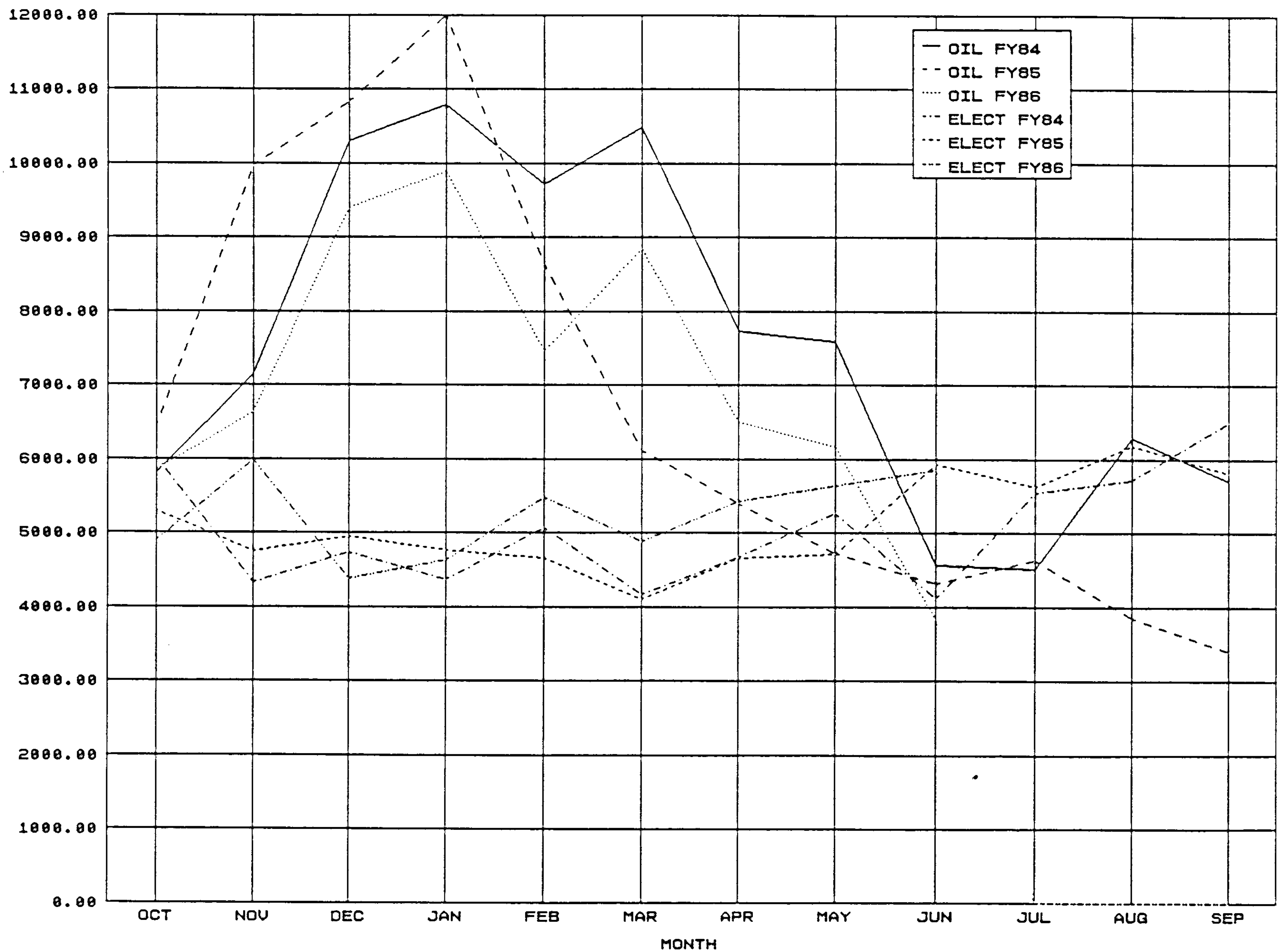


Figure 4–2

4. HISTORICAL ENERGY CONSUMPTION

Refer to Figures 4-3, 4-4, and 4-5. These are stacked area graphs. These graphs emphasize again the fact that the month to month variation in electric energy use is small. The shape of the electric energy use curve follows closely the shape of the fuel oil energy use. Also, note the significant base load of fuel used year round. This is primarily for reheat energy. This energy will be reduced significantly by the projects which have been developed by the facility.

In reviewing a previous EEAP program project provided by the Louisville District, a graph showing source energy of several other army hospital facilities was discovered. Data was taken from this graph and is represented in Figure 4-6. The data for Blanchfield has been added for comparison purposes. Other data which would increase the value of this comparison such as floor areas, patient bed, etc., were not available, and, while interesting, would be of little use to the facility.

BACH HISTORICAL ENERGY CONSUMPTION BY TYPE FOR FY84
IN MILLIONS OF BTU

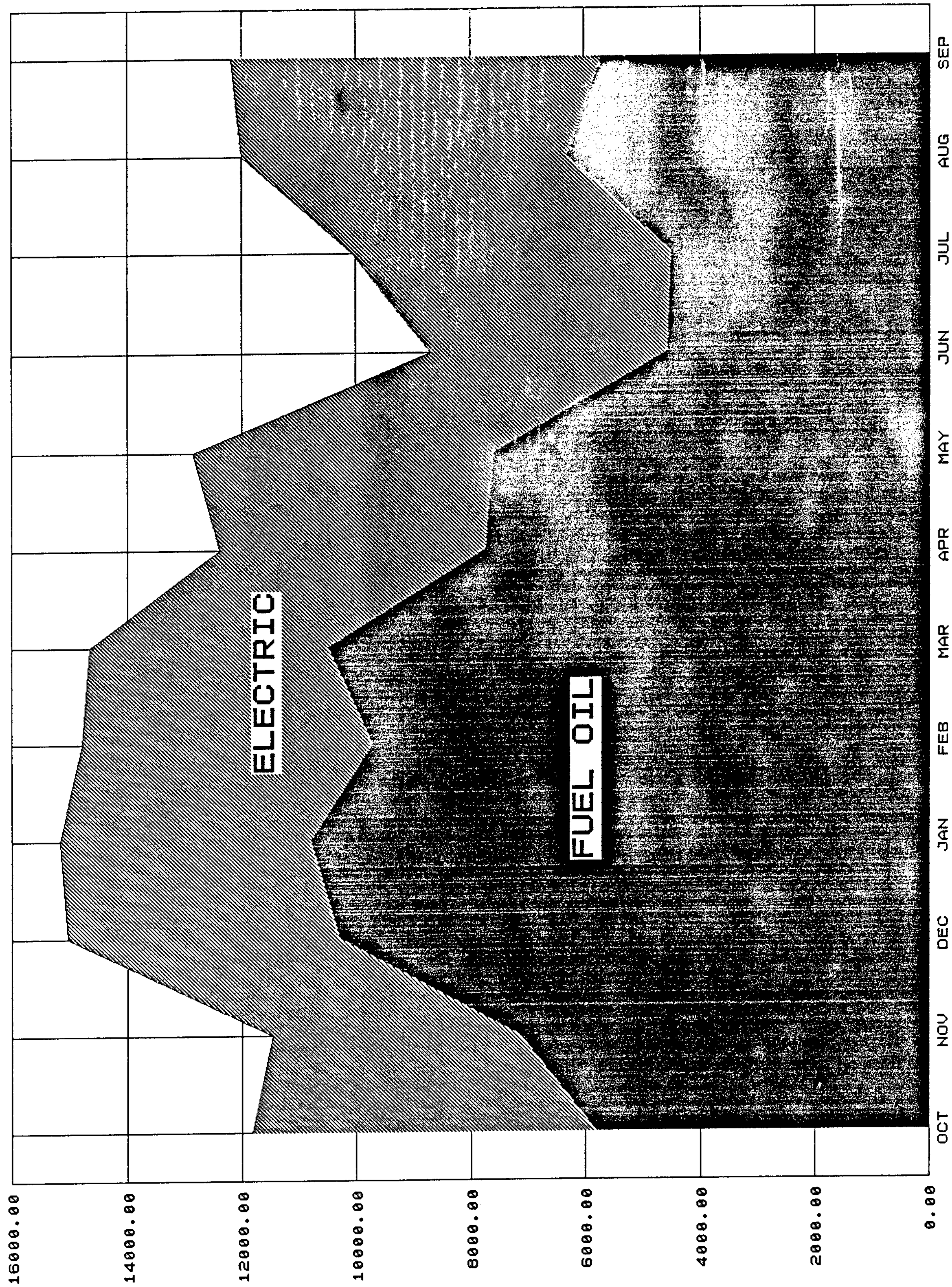


Figure 4-3

BACH HISTORICAL ENERGY CONSUMPTION BY TYPE FOR FY85
IN MILLIONS OF BTU

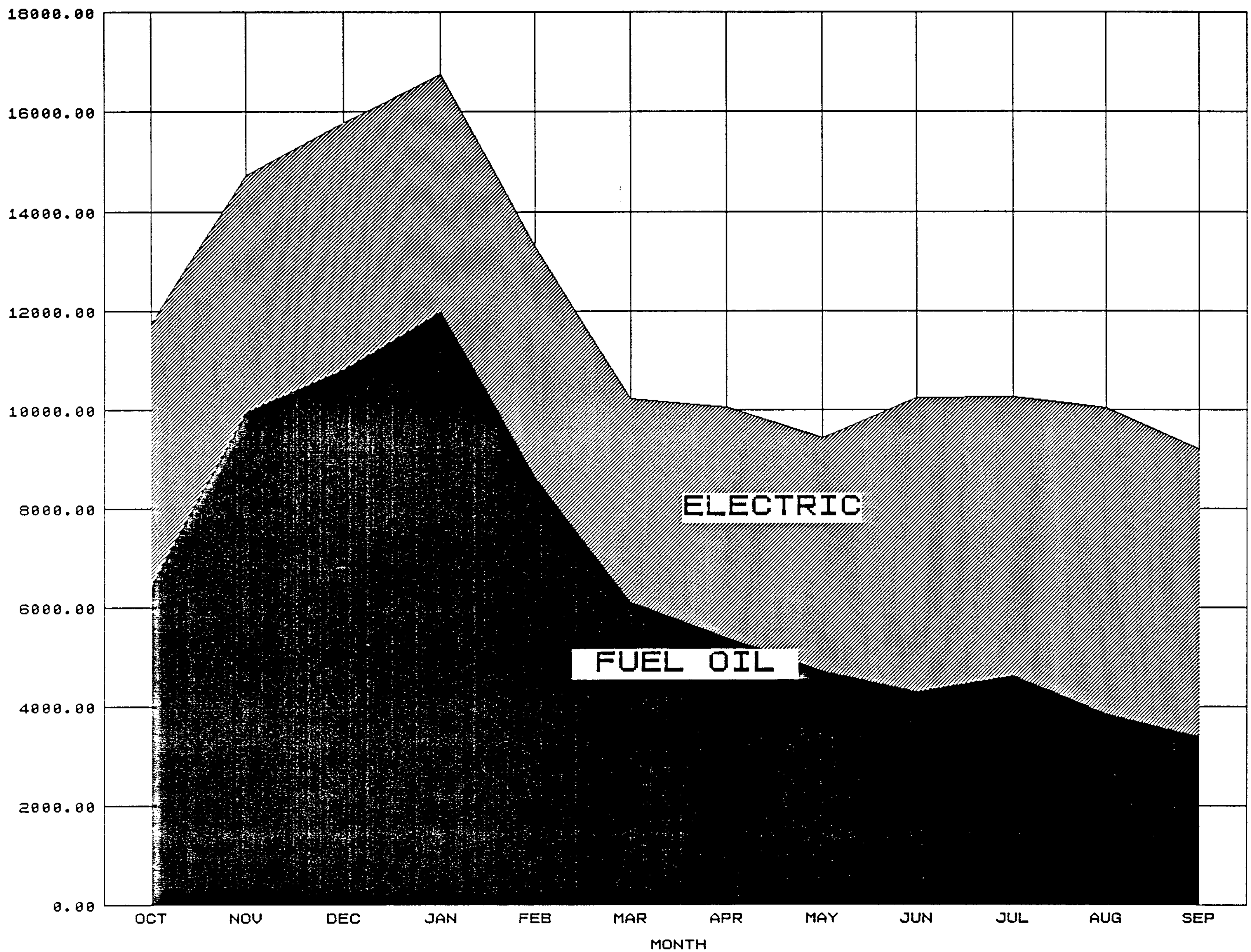


Figure 4—4

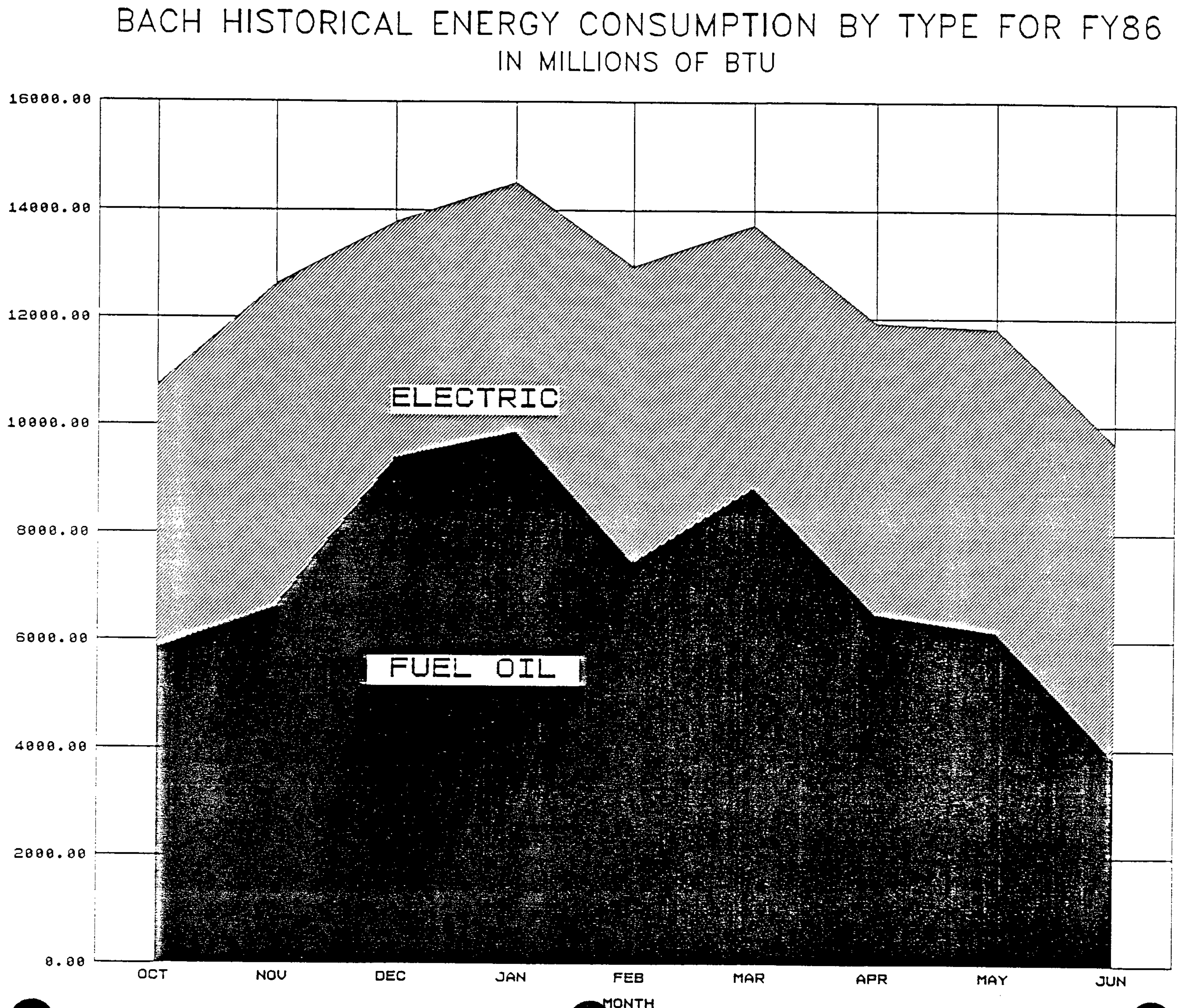
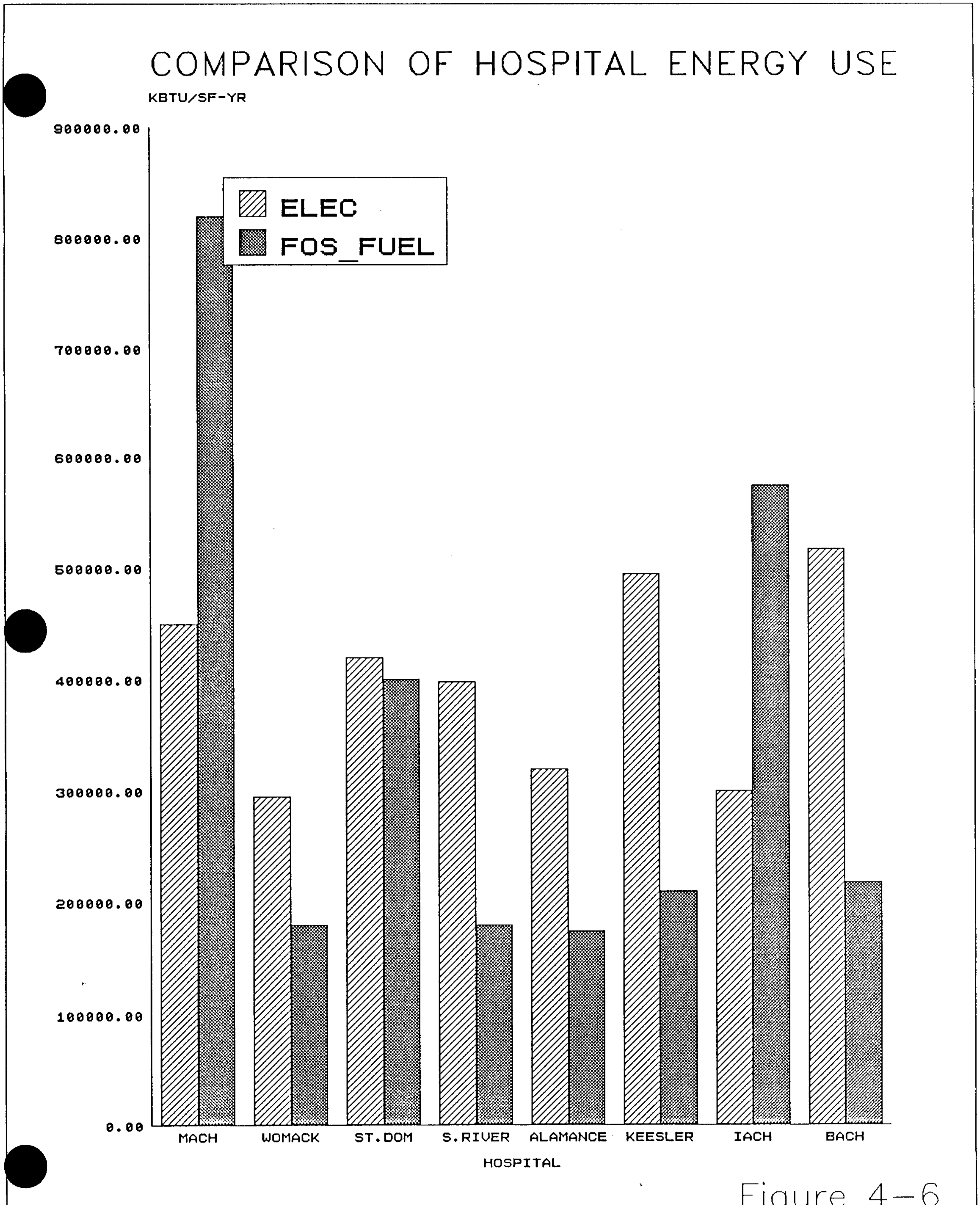

BACH HISTORICAL ENERGY CONSUMPTION BY TYPE FOR FY86
IN MILLIONS OF BTU
16000.00
14000.00
12000.00
10000.00
8000.00
6000.00
4000.00
2000.00
0.00
ELECTRIC
FUEL OIL
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
MONTH

Figure 4-



COMPARISON OF HOSPITAL ENERGY USE
KBTU/SF-YR
900000.00
800000.00
700000.00
600000.00
500000.00
400000.00
300000.00
200000.00
100000.00
0.00
ELEC
FOS_FUEL
MACH
WOMACK
ST.DOM
S.RIVER
ALAMANCE
KEESLER
IACH
BACH
HOSPITAL

Figure 4-6

5. ENERGY CONSERVATION ANALYSIS

5.1 ECO's Investigated

All of the ECO's (Energy Conservation Opportunities) which were included in the scope of work in this project were investigated for each building in accordance with the scope of work. The scope of work is included in Appendix A of the full report for reference. It was possible to eliminate many of the ECO's for specific buildings based on engineering judgment and the specific applicability of an ECO to the energy systems in that building. Table 5-1 is a listing of all the ECO's by building, with an "X" under the "YES" or "NO" column to indicate whether or not an ECO was recommended for implementation. An "X" under the "NO" column does not indicate that it was not evaluated.

The ECO's which were judged to be applicable to the energy systems in the building were then evaluated and either recommended or rejected. A summary of the ECO's which were evaluated in detail are included in Section 5.2, and a summary of those which were rejected are included in Section 5.3 of this Executive Summary.

The criteria for recommending or rejecting specific ECO's is in accordance with the scope of work for the project and varies depending on building specific characteristics. All ECO's were forwarded to Tom Sweet, Army Corps of Engineers Project Manager, the Hospital Commander, and the Director of Engineering and Housing for packaging ECO's for programming purposes. Each of these ECO's was packaged per directions from Mr. Sweet. All ECO's which were not packaged are included in Volume 3, Tab 9, as Non-Programmed ECO's. This section is further subdivided into the following subsections. Each ECO with a payback of less than one year was recommended as a no cost/low cost project. Other ECO's having an SIR of greater than 1.0 were left as non-programmed projects, but should be strongly considered for future implementation. These ECO's have simple paybacks ranging from 1.25 years to 5.41 years. The remaining ECO's had paybacks in excess of 6.0 years and were non-recommended. It should be noted, however, that some of these projects have SIR's of greater than 1.0 and may be considered as marginal projects for future implementation.

TABLE 5-1

FACILITY: BACH Bldgs. A, B, C, D

Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A. Heating, Ventilating, and Air Conditioning			
1. Cycle On/Off Air Handler		X	Minimum hospital airflow requirements. The need to minimize airborne contaminants does not allow this strategy.
2. Reduce Heating/Cooling Outside Air	X		Partially effective; see Item A.3.
3. Reduce Recirculated Air Volume	X		Convert dual duct systems to dual duct VAV and constant volume terminal reheat to VAV.
4. Cycle On/Off Room Fan Coil Unit		X	There are no systems of this type in the building.
5. Cycle Reduce Stairwell Heat		X	Stairwell heat was found to be minimal during the survey.
6. Cycle Circulating Pumps	X		Install primary/secondary variable volume pumping.
7. Reduce Humidification to Minimum		X	Humidification is already maintained at minimum levels.
8. Reduce Condenser Water Temperature	X		Condenser water temperature will be reduced through the use of a more efficient chiller.
9. Cycle Fans and Pumps	X		See Items A.3 and A.6.
10. Reduce Water Flow Rates	X		See Item A.6.

TABLE 5-1

FACILITY: BACH Bldgs. A, B, C, D

Fort Campbell, Kentucky

	ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A.	Heating, Ventilating, and Air Conditioning (Continued)			
11.	Space Temperature Reset		X	NA, although this capability will be incorporated into the EMCS for hot and cold deck reset.
12.	Steam Line and Trap Maintenance		X	Steam system and trap maintenance is in order. There are no opportunities here.
13.	Shut Off Air to Unoccupied Area		X	The only area where this might be considered is in the ICU which was only partially occupied. However, in order to keep this area in readiness condition, airflow must be maintained.
14.	Reset H&C Deck	X		Modify existing EMCS.
15.	Reset/Raise CHS Temperature		X	Not practical due to excessive fan hp and humidity control criteria.
16.	Load Shed		X	Lack of non-critical loads
17.	Free Cooling with Outside Air		X	All existing systems presently have economizers.

TABLE 5-1

FACILITY: BACH Bldgs. A, B, C, D — Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A. Heating, Ventilating, and Air Conditioning (Continued)			
18. Reduction of Reheat	X		See Item A.14.
19. H&C Energy Recovery		X	Exhaust air streams are not located central to air handling equipment. Also, the availability and demand are not well matched to provide any appreciable savings.
20. Reduce CHS Circulation	X		See Item A.6.
21. Reduced Motor Sizing		X	Motors are properly sized for the equipment. No reductions are feasible.
22. Replace Manual Valves with Automatic	X		Control existing perimeter heating system.
23. Install VAV Controls	X		See Item A.3.
24. Insulate Ducts and Piping		X	Existing well insulated.
25. Eliminate Simultaneous Heating and Cooling	X		See Item A.14 for reduction.

TABLE 5-1

FACILITY: BACH Bldgs. A, B, C, D

Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A. Heating, Ventilating, and Air Conditioning (Continued)			
26. Install NSB Controls		X	Most areas of the hospital are occupied on a 24-hour basis. Office areas contain medical and other records which should be maintained at constant temperatures. Also, there is very little savings because these areas have little or no load during off hours.
27. Clean Coils	X		This is a recommended ECO.
28. Maintain Filters	X		This is a recommended ECO.
29. Repair/Maintain AHU Controls	X		Unit AC-C-16 discharge pressure control system.
30. Multiple/Variable Speed CT Fan Control		X	Sufficient existing stages for free cooling. Economizers limit operation of tower. Not cost effective.
31. Use Centrifugal vs Absorption Chiller		X	The hospital currently operates its centrifugal chillers its primary units and uses the absorption chiller only as backup.

TABLE 5-1

FACILITY: BACH Bldgs. A, B, C, D

Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A. Heating, Ventilating, and Air Conditioning (Continued)			
32. Investigate Pressure Conditions		X	Existing air balance/design problem in Building B compounded by lack of use of makeup air system. Not an ECO.
33. Investigate Revised VAV, Bldg. C		X	Existing system very efficient; perimeter heating modifications should solve bulk of problems.
B. Boiler Plant			
1. Boiler and Chiller Control Modifications	X		Install O_2 analyzers and trim to replace existing.
2. Common Manifold Chillers	X		See Item A.6.
C. Lighting			
1. Turn Off Lights Not Needed	X		Should be done by individual hospital personnel.
2. Reduce Lighting Levels		X	Lighting levels are consistent with good design and the functional use of the areas. Lighting levels were generally found to be inadequate in the main storage areas.

TABLE 5-1

FACILITY: BACH Bldgs. A, B, C, D

Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
C. Lighting (Continued)			
3. Revise Cleaning Schedule		X	Cleaning schedules are not impacting lighting energy use in the hospital.
4. Convert to Energy Efficient System		X	Existing system is efficient.
D. Electrical			
1. Cycle Off Elevators Not Needed		X	This was analyzed and found not to be cost effective.
2. Cycle Off Pneumatic Tube System		X	Existing system control and operation is energy conserv- ing. We do not recommend cycling these units due to increased maintenance and high start-up loads.

TABLE 5-1

FACILITY: BACH Bldgs. A, B, C, D

Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
D. Electrical (Continued)			
3. Improve Power Factor		X	This ECO has been evaluated and is addressed in other ECOs as follows: 1. Chillers to be replaced should be specified as high efficiency high power factor motors. 2. Power factor for fans and pumps provided with variable frequency invertors will be corrected to .96 by the invertor. 3. Motors to be replaced under another ECO are specified to be high efficiency high power factor motors.
4. Use Emergency Generator Peak Shave		X	This was evaluated, and an SIR of .97 was obtained. This ECO was not recommended for this reason.
5. Load Shed or Cycle Electric		X	Use of VAV and variable volume pumping will improve situation.

TABLE 5-1

FACILITY: BACH Bldgs. A, B, C, D — Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
D. Electrical (Continued)			
6. Balance Loads		X	The system design indicates and field surveys confirmed that the electrical loads in the complex are well balanced.
7. Reduce Transformer Loss/Load & B.		X	The electrical system is relatively new. Loads are balanced and not excessive for transformers. There are no ECOs recommended here.
8. Use Energy Efficient Motors		X	This has been evaluated, and some motors will be replaced under one of these projects.
9. Variable Volume Pumping	X		See Item A.6.

TABLE 5-1

FACILITY: BACH Bldgs. A, B, C, D — Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
E. Building			
1. Reduce Infiltration		X	This has been evaluated by addressing the possibility of enclosing the loading dock and providing vestibules at entrances. While it would improve comfort conditions, the savings in energy does not justify the project. Current energy use to offset infiltration is relatively small due to systems inability to handle the load.
2. Install Insulated Glazing		X	Existing windows are double glazed.
3. Enclose Loading Dock		X	It is presently a temperature control problem and not an energy conservation problem.
4. Install Vestibules		X	This ECO was evaluated and found not to be cost effective. This is partially due to inadequate heating system.
5. Solar Shading		X	Existing reveal/blinds are very effective. No additional shading devices are necessary.

TABLE 5-1

FACILITY: BACH Bldgs. A, B, C, D

Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
E. Building (Continued)			
6. Wall Insulation		X	Existing insulation is very cost effective. Building is new and insulation provided is adequate.
F. Kitchen			
1. Cycle Range Hood Exhaust	X		Use makeup air system.
2. Install High Efficiency Steam Control		X	Existing controls are energy efficient.
3. Cycle Appliances and Equipment		X	Appliances are primarily steam and natural gas. Cycling provides no energy savings.
4. Install MASU for Exhaust		X	There is an existing makeup air supply unit.
5. Exhaust Heat Reclaim		X	Increased maintenance costs required to service the equipment and to keep cleaned so that heat transfer surfaces are efficient and capital cost of equipment render this ECO not cost effective.

TABLE 5-1

FACILITY: BACH Bldgs. A, B, C, D — Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
F. Kitchen (Continued)			
6. Cycle Lights in Cooler		X	This does not require remote control and is an operating strategy.
7. Heat Pump Water Heater		X	Existing system is very cost effective. The cost of additional maintenance and the low cost of residual fuel renders this ECO not cost effective. High capital cost of equipment required to pick up heat and redistribute the cooled air also contribute to making this ECO infeasible.
G. Plumbing			
1. Reduce Domestic Hot Water Temperature	X		Program has been recommended at exit interview.
2. Repair/Maintain Steam/Hot Water Pipe Insulated		X	This facility is relatively new, and insulation is in good condition.
3. Install Flow Restrictors		X	The fixtures specified and provided in the original project are flow restricted type.

TABLE 5-1

FACILITY: BACH Bldgs. A, B, C, D — Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
G. Plumbing (Continued)			
4. Install Automatic Shutoff Faucets		X	Not required. Survey indicated no faucets left running. These can become more of a maintenance problem than they benefit.
5. Decentralize Hot Water Heating		X	Primary heating system is cost effective. Decentralizing the system increases maintenance and reduces system reliability. High capital cost to repipe recirculating system and provide energy source to generate the hot water renders this ECO not cost effective.
6. Add Pipe Insulation		X	THis is a recommended ECO.
H. Miscellaneous			
1. Install Heat Rec. for Incinerator		X	Because of current issues relative to EPA regulation and hazardous waste classifications of pathological incinerators, no ECO is recommended for heat recovery.

TABLE 5-1

FACILITY: BACH Bldgs. A, B, C, D

Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
H. Miscellaneous (Continued)			
2. Install Computerized EMCS	X		Existing system will be modified to include temperature reset and enthalpy economizer
3. Convert Steam Turbine to Elec. Mt.		X	This ECO is not cost effective. The cost of steam to drive the turbines is low. The capital cost of a new motor starter, wiring, etc. makes the project infeasible.
4. Install Water Softener/Dr.		X	We cannot identify any energy savings to be gained by adding a water softener at central material services or the dining area.
5. Occupancy Sensors to Cycle Loads		X	This would require extensive rework of the electrical system for other than light fixtures. HVAC is sensitive to occupancy through the thermostat. Lighting loads do not provide sufficient savings to offset costs.

Table 5-1

FACILITY: Epperly Dental Clinic

Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A. Heating, Ventilating, and Air Conditioning			
1. Cycle On/Off Air Handler		X	Already on time clock.
2. Reduce Heating/Cooling Outside Air		X	Outside air is appropriate for the facility.
3. Reduce Recirculated Air Volume		X	Air quantities are as required to meet the load.
4. Cycle On/Off Room Fan Coil Unit		X	There are no room fan coil units in this building.
5. Cycle Reduce Stairwell Heat		X	There are no stairwells in this building.
6. Cycle Circulating Pumps		X	Pumps already cycle.
7. Reduce Humidification to Minimum		X	Humidification is currently at minimum levels.
8. Reduce Condenser Water Temperature		X	No cooling tower.
9. Cycle Fans and Pumps		X	Already cycle.
10. Reduce Water Flow Rates		X	Water flow rates are appropriate for the system design.
11. Space Temperature Reset		X	Deck temperatures are reset as a function of space load.

Table 5-1

FACILITY: Epperly Dental Clinic | Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A. Heating, Ventilating, and Air Conditioning (Continued)			
12. Steam Line and Trap Maintenance		X	Steam line and traps were properly maintained at the time of our survey.
13. Shut Off Air to Unoccupied Area		X	The conversion to VAV will achieve this thermostatically.
14. Reset H&C Deck		X	Heating is reset on OA temperature, and cold deck is reset on space load.
15. Reset/Raise CHS Temperature		X	CHS is from central plant; therefore, it cannot be reset from this load alone. This could be considered for basewide EMCS if other buildings in the area were included.
16. Load Shed		X	No savings to be gained unless programmed with the whole base on the basewide EMCS.
17. Free Cooling with Outside Air		X	Existing enthalpy economizer.

Table 5-1

FACILITY: Epperly Dental Clinic | Fort Campbell, Kentucky

	ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A.	Heating, Ventilating, and Air Conditioning (Continued)			
18.	Reduction of Reheat		X	Reheat will be reduced by converting the dual duct system to VAV.
19.	H&C Energy Recovery		X	This system has an existing glycol coil runaround heat recovery loop.
20.	Reduce CHS Circulation		X	CHS circulation is appropriate to the load.
21.	Reduced Motor Sizing		X	Motors are properly sized for the systems.
22.	Replace Manual Valves with Automatic		X	There are no manual type control valves for heating or cooling temperature control.
23.	Install VAV Controls	X		This is a recommended ECO.
24.	Insulate Ducts and Piping		X	Duct and piping insulation are appropriate.
25.	Eliminate Simultaneous Heating and Cooling	X		Conversion to VAV will reduce simultaneous heating and cooling.
26.	Install NSB Controls		X	Existing NSB controls.

FACILITY: Epperly Dental Clinic — Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A. Heating, Ventilating, and Air Conditioning (Continued)			
27. Clean Coils		X	Survey did not indicate that coils were dirty.
28. Maintain Filters		X	Filters are regularly maintained.
29. Repair/Maintain AHU Controls	X		Controls are in good condition. Some revisions will be made to convert to VAV system.
30. Multiple/Variable Speed CT Fan Control		X	There is no cooling tower in this facility.
31. Use Centrifugal vs Absorption Chiller		X	There is no absorption chiller in this facility.
32. Investigate Pressure Conditions		X	This ECO applies specifically to the hospital complex.
33. Investigate Revised VAV, Bldg. C		X	This ECO refers specifically to Building C of the hospital complex.
B. Boiler Plant			
1. Boiler and Chiller Control Modifications		X	There is no boiler or chiller in this facility.

Table 5-1

FACILITY: Epperly Dental Clinic

Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
B. Boiler Plant (Continued)			
2. Common Manifold Chillers		X	There are no multiple chillers to manifold in this facility.
C. Lighting			
1. Turn Off Lights Not Needed		X	The survey indicates that this is currently being done.
2. Reduce Lighting Levels		X	Lighting levels are appropriate for space functions and have multilevel switching capability.
3. Revise Cleaning Schedule		X	There is no indication that the cleaning schedule impacts energy consumption in this building.
4. Convert to Energy Efficient System		X	The existing lighting system is energy efficient with a combination of daylighting and multilevel switching.
D. Electrical			
1. Cycle Off Elevators Not Needed		X	There are no elevators in this facility.
2. Cycle Off Pneumatic Tube System		X	There is no pneumatic tube system in this facility.

Table 5-1

FACILITY: Epperly Dental Clinic — Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
D. Electrical (Continued)			
3. Improve Power Factor		X	There are only a small number of inactive loads. Power factor is not a problem in this facility.
4. Use Emergency Generator Peak Shave		X	There is no emergency generator in this facility.
5. Load Shed or Cycle Electric		X	There are very few sheddable loads in this facility. The energy savings potential is small and considerable investment would be required.
6. Balance Loads		X	Existing loads are reasonably well balanced as indicated by the field survey and the drawings.
7. Reduce Transformer Loss/Load & B.		X	Transformer loading is appropriate for building loads.
8. Use Energy Efficient Motors			
9. Variable Volume Pumping		X	Pumps are cycled off. System is too small to net significant savings.

Table 5-1

FACILITY: Epperly Dental Clinic | Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
E. Building			
1. Reduce Infiltration	X		This is a recommended ECO.
2. Install Insulated Glazing		X	There is minimal glazing in the building and most is already insulated.
3. Enclose Loading Dock		X	There is no loading dock in this facility.
4. Install Vestibules		X	There is an existing vestibule at the main entrance.
5. Solar Shading		X	Glazing is already shaded with existing blinds.
6. Wall Insulation		X	Existing building insulation is adequate.
F. Kitchen			
1. Cycle Range Hood Exhaust		X	There is no commercial kitchen in this facility.
2. Install High Efficiency Steam Control		X	There are no steam cooking appliances in this facility.
3. Cycle Appliances and Equipment		X	There are no cooking appliances in this facility.
4. Install MASU for Exhaust		X	There is no hood exhaust.

Table 5-1

FACILITY: Epperly Dental Clinic

Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
F. Kitchen (Continued)			
5. Exhaust Heat Reclaim		X	There is no major hood exhaust heat.
6. Cycle Lights in Cooler		X	There are no coolers.
7. Heat Pump Water Heater		X	There is no large cooking or dishwashing hot water load.
G. Plumbing			
1. Reduce Domestic Hot Water Temperature		X	This program was recommended at the exit interview.
2. Repair/Maintain Steam/Hot Water Pipe Insulated		X	Insulation is in good condition.
3. Install Flow Restrictors		X	Simple payback is in excess of six years.
4. Install Automatic Shutoff Faucets		X	The field survey did not indicate that automatic shutoff faucets are required.
5. Decentralize Hot Water Heating		X	The central hot water system is appropriate for this facility.
6. Add Pipe Insulation		X	Existing pipe insulation is appropriate for system fluid temperatures.

Table 5-1

FACILITY: Epperly Dental Clinic

Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
H. Miscellaneous			
1. Install Heat Rec. for Incinerator		X	There is no incinerator in this project.
2. Install Computerized EMCS		X	The potential for savings from this building alone is not sufficient to support tying into the basewide EMCS.
3. Convert Steam Turbine to Elec. Mt.		X	There is no steam turbine in this facility.
4. Install Water Softener/Dr.		X	There is a small demineralizer currently serving these needs effectively.
5. Occupancy Sensors to Cycle Loads		X	Occupancy patterns and loads are not such that significant savings will be achieved.

TABLE 5-1

FACILITY: Taylor Dental Clinic — Fort Campbell, Kentucky

	ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A.	Heating, Ventilating, and Air Conditioning			
1.	Cycle On/Off Air Handler		X	Existing time clock.
2.	Reduce Heating/Cooling Outside Air		X	Outside air quantities are appropriate for the building. Air systems are shut off at night.
3.	Reduce Recirculated Air Volume		X	Recirculated air volume is appropriate to meet the building loads.
4.	Cycle On/Off Room Fan Coil Unit		X	There are no units of this type in the building.
5.	Cycle Reduce Stairwell Heat		X	The building is single story.
6.	Cycle Circulating Pumps	X		CW pumps.
7.	Reduce Humidification to Minimum		X	The only humidification is at Oral Surgery, and it is of the low energy atomizing type.
8.	Reduce Condenser Water Temperature		X	No cooling tower.
9.	Cycle Fans and Pumps		X	See A1 and A6.
10.	Reduce Water Flow Rates		X	Water flow rates are appropriate for the loads.
11.	Space Temperature Reset		X	CW temperature reset by room thermostat.
12.	Steam Line and Trap Maintenance		X	Natural gas hot water boiler.

TABLE 5-1

FACILITY: Taylor Dental Clinic

Fort Campbell, Kentucky

	ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A.	Heating, Ventilating, and Air Conditioning (Continued)			
13.	Shut Off Air to Unoccupied Area		X	VAV controls will reduce air flow in unoccupied areas based on load.
14.	Reset H&C Deck		X	See A11, HW temperature reset on outdoor thermostat.
15.	Reset/Raise CHS Temperature		X	CHS already at 54° F.
16.	Load Shed		X	Load shedding is inappropriate for this facility. Other controls are recommended in other ECOs which provide better results.
17.	Free Cooling with Outside Air	X		Enthalpy economizer locked in minimum position. Recommending ECO to reactivate existing economizer.
18.	Reduction of Reheat	X		This is a recommended ECO.
19.	H&C Energy Recovery		X	There is very little energy available to recover, particularly with reduction of reheat.

TABLE 5-1

FACILITY: Taylor Dental Clinic — Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A. Heating, Ventilating, and Air Conditioning (Continued)			
20. Reduce CHS Circulation		X	Chilled water circulation is appropriate for the load.
21. Reduced Motor Sizing		X	Motor sizes are appropriate for the equipment served.
22. Replace Manual Valves with Automatic		X	Already automatic.
23. Install VAV Controls	X		This is a recommended ECO.
24. Insulate Ducts and Piping		X	Insulation in good shape.
25. Eliminate Simultaneous Heating and Cooling		X	This is being reduced by A.23.
26. Install NSB Controls		X	Existing NSB.
27. Clean Coils			Field survey revealed coils are clean.
28. Maintain Filters		X	Filters appear to be maintained regularly according to field survey data.
29. Repair/Maintain AHU Controls	X		Provided under economizer and VAV control ECO.
30. Multiple/Variable Speed CT Fan Control		X	No cooling tower.
31. Use Centrifugal vs Absorption Chiller		X	No absorption chiller in this facility.

TABLE 5-1

FACILITY: Taylor Dental Clinic — Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A. Heating, Ventilating, and Air Conditioning (Continued)			
32. Investigate Pressure Conditions		X	There are no building pressurization problems in this facility.
33. Investigate Revised VAV, Bldg. C		X	This applies only to hospital Building C.
B. Boiler Plant			
1. Boiler and Chiller Control Modifications		X	Boiler and chiller controls are appropriate for the facility.
2. Common Manifold Chillers		X	There is only one chiller for this facility.
C. Lighting			
1. Turn Off Lights Not Needed		X	This is done by the occupants.
2. Reduce Lighting Levels		X	Lighting levels are appropriate for the space uses.
3. Revise Cleaning Schedule		X	Cleaning cannot be accomplished during building occupancy hours.
4. Convert to Energy Efficient System		X	The existing lighting system is energy efficient.

TABLE 5-1

FACILITY: Taylor Dental Clinic

Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
D. Electrical			
1. Cycle Off Elevators Not Needed		X	There are no elevators in this facility.
2. Cycle Off Pneumatic Tube System		X	There is no pneumatic tube system in this facility.
3. Improve Power Factor		X	This facility is not metered, and power factor will have no effect on the base metering.
4. Use Emergency Generator Peak Shave		X	There is no emergency generator in this facility.
5. Load Shed or Cycle Electric		X	Other ECOs recommended minimize savings available from this ECO. There are not sufficient loads to shed or cycle.
6. Balance Loads		X	Loads are balanced.
7. Reduce Transformer Loss/Load & B.		X	Transformer sizes are appropriate.

TABLE 5-1

FACILITY: Taylor Dental Clinic

Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
D. Electrical (Continued)			
8. Use Energy Efficient Motors		X	Motors are cycled and therefore have short runtimes. Base maintenance should replace failed motors with new high efficiency high power factor motors as a matter of practice.
9. Variable Volume Pumping		X	Constant flow must be maintained through chiller and boiler. ECO recommends turning pumps off when air handlers are off.
E. Building			
1. Reduce Infiltration	X		This is a recommended ECO.
2. Install Insulated Glazing		X	The amount of glazing in the building is small and therefore would not provide savings sufficient to be considered.
3. Enclose Loading Dock		X	This facility does not have a loading dock.
4. Install Vestibules		X	This facility has an existing vestibule at the primary building entrance.

TABLE 5-1

FACILITY: Taylor Dental Clinic — Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
E. Building (Continued)			
5. Solar Shading		X	This facility has blinds to provide solar shading.
6. Wall Insulation		X	Wall insulation for this facility is adequate.
F. Kitchen			
1. Cycle Range Hood Exhaust		X	There is no commercial kitchen in this facility.
2. Install High Efficiency Steam Control		X	Same as F.1 above.
3. Cycle Appliances and Equipment		X	Same as F.1 above.
4. Install MASU for Exhaust		X	Same as F.1 above.
5. Exhaust Heat Reclaim		X	Same as F.1 above.
6. Cycle Lights in Cooler		X	Same as F.1 above.
7. Heat Pump Water Heater		X	Same as F.1 above.
G. Plumbing			
1. Reduce Domestic Hot Water Temperature		X	This was recommended at the exit interview.

TABLE 5-1

FACILITY: Taylor Dental Clinic

Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
G. Plumbing (Continued)			
2. Repair/Maintain Steam/Hot Water Pipe Insulated		X	Field survey notes indicate that existing insulation is in good condition.
3. Install Flow Restrictors	X		This is a recommended ECO.
4. Install Automatic Shutoff Faucets		X	There is no indication that this will conserve energy in this facility.
5. Decentralize Hot Water Heating		X	The hot water system is very compact and accessible as installed. Decentralization provides no benefits.
6. Add Pipe Insulation		X	Existing pipe insulation is adequate for the ambient and fluid temperatures encountered in this facility.
H. Miscellaneous			
1. Install Heat Rec. for Incinerator		X	There is no incinerator at this facility.
2. Install Computerized EMCS		X	Local control loops and time clocks are adequate. The building is too small for an EMCS.

TABLE 5-1

FACILITY: Taylor Dental Clinic | Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
H. Miscellaneous (Continued)			
3. Convert Steam Turbine to Elec. Mt.		X	There are no steam turbines in this facility.
4. Install Water Softener/Dr.		X	Water softeners are not required for this facility.
5. Occupancy Sensors to Cycle Loads		X	Occupancy patterns are not such that appreciable savings will be obtained. Manual switching of lights and thermostatic sensing of HVAC loads is sufficient for this facility.

FIGURE 5-1

FACILITY: Kuhn Dental Clinic — Fort Campbell, Kentucky

	ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A.	Heating, Ventilating, and Air Conditioning			
1.	Cycle On/Off Air Handler		X	This system requires air handlers to run to maintain minimum and maximum conditions.
2.	Reduce Heating/Cooling Outside Air		X	Quantities are appropriate for areas served.
3.	Reduce Recirculated Air Volume		X	Quantities are appropriate for areas served.
4.	Cycle On/Off Room Fan Coil Unit		X	There are no room fan coil units.
5.	Cycle Reduce Stairwell Heat		X	There are no stairwells.
6.	Cycle Circulating Pumps		X	Circulating pumps are currently cycled.
7.	Reduce Humidification to Minimum		X	There are no humidifiers in this facility.
8.	Reduce Condenser Water Temperature		X	See note below.
9.	Cycle Fans and Pumps		X	This is done as part of existing system.
10.	Reduce Water Flow Rates		X	Water flow rates are appropriate for the loads.
11.	Space Temperature Reset		X	Deck temperatures are reset.

FIGURE 5-1

FACILITY: Kuhn Dental Clinic

Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A. Heating, Ventilating, and Air Conditioning (Continued)			
12. Steam Line and Trap Maintenance	X		This is a recommended ECO.
13. Shut Off Air to Unoccupied Area		X	Occupancy patterns for this facility do not make this ECO feasible.
14. Reset H&C Deck		X	Water temperatures are currently reset. Deck temperatures are maintained constant except hot deck is reset with outdoor air.
15. Reset/Raise CHS Temperature		X	Existing equipment is controlled with 50°F water temperature.
16. Load Shed		X	There are minimal loads to be shed in this building. It would not be appropriate unless tied to the basewide EMCS.
17. Free Cooling with Outside Air		X	Not appropriate for a multizone system.
18. Reduction of Reheat		X	This is not a reheat system.
19. H&C Energy Recovery		X	Energy available to recover is minimal and not readily available in a form to reuse.

FIGURE 5-1

FACILITY: Kuhn Dental Clinic — Fort Campbell, Kentucky

	ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A.	Heating, Ventilating, and Air Conditioning (Continued)			
20.	Reduce CHS Circulation		X	Chilled water circulation is appropriate for the loads.
21.	Reduced Motor Sizing		X	Motor sizes are appropriate for the system.
22.	Replace Manual Valves with Automatic		X	There are no manual control valves.
23.	Install VAV Controls		X	This would require total system replacement and is not cost effective.
24.	Insulate Ducts and Piping		X	Insulation is in good condition and appropriate for fluid temperatures.
25.	Eliminate Simultaneous Heating and Cooling		X	This can be done by turning off hot water pump in summer and chilled water pump in winter by operating personnel.
26.	Install NSB Controls		X	Existing.
27.	Clean Coils		X	Field survey indicates that coils are clean.
28.	Maintain Filters		X	Filters are being maintained.

FIGURE 5-1

FACILITY: Kuhn Dental Clinic | Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A. Heating, Ventilating, and Air Conditioning (Continued)			
29. Repair/Maintain AHU Controls		X	Controls appear to be operating satisfactorily.
30. Multiple/Variable Speed CT Fan Control		X	Fan control is not appropriate for this system.
31. Use Centrifugal vs Absorption Chiller		X	There is no absorption chiller in this building.
32. Investigate Pressure Conditions		X	This ECO is applicable only to the hospital complex.
33. Investigate Revised VAV, Bldg. C		X	This ECO is applicable only to the hospital complex.

NOTE: Existing building systems are in excess of 25 years old and have fulfilled their economic life. We recommend considering a major renovation. However, this is not an energy conservation measure.

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
B. Boiler Plant			
1. Boiler and Chiller Control Modifications		X	There is no boiler in this facility.
2. Common Manifold Chillers		X	There is only one chiller in this facility.
C. Lighting			
1. Turn Off Lights Not Needed		X	This is existing.

FIGURE 5-1

FACILITY: Kuhn Dental Clinic — Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
C. Lighting (Continued)			
2. Reduce Lighting Levels		X	Lighting levels are appropriate for the use (somewhat low).
3. Revise Cleaning Schedule		X	Cleaning schedule does not impact energy consumption.
4. Convert to Energy Efficient System		X	This was evaluated and found not to be cost effective.

NOTE: Existing building systems are in excess of 25 years old and have fulfilled their economic life expectancy. We recommend considering a major renovation. However, this is not an ECO.

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
D. Electrical			
1. Cycle Off Elevators Not Needed		X	There are no elevators in this facility.
2. Cycle Off Pneumatic Tube System		X	There are no pneumatic tube systems in this facility.
3. Improve Power Factor		X	This is not cost effective due to base metering system.
4. Use Emergency Generator Peak Shave		X	There is no emergency generator in this building.
5. Load Shed or Cycle Electric		X	This would require tying into the basewide EMCS. This is not cost effective as a single project.

FIGURE 5-1

FACILITY: Kuhn Dental Clinic

Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
D. Electrical (Continued)			
6. Balance Loads		X	Loads are balanced.
7. Reduce Transformer Loss/Load & B.		X	Transformers are appropriately sized.
8. Use Energy Efficient Motors		X	This was evaluated and found not to be cost effective.
9. Variable Volume Pumping		X	Flow through the chiller must be constant. Hot water pumps are zoned and run with load. There is little savings to be gained.

NOTE: Existing building systems are in excess of 25 years old and have fulfilled their economic life expectancy. We recommend a major renovation be considered. However, this is not an ECO.

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
E. Building			
1. Reduce Infiltration		X	Simple payback is too long.
2. Install Insulated Glazing		X	This was evaluated and found not to be cost effective.
3. Enclose Loading Dock		X	There is no loading dock at this building.
4. Install Vestibules		X	Existing vestibule.
5. Solar Shading		X	This was evaluated and found not to be cost effective.

FIGURE 5-1

FACILITY: Kuhn Dental Clinic — Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
E. Building (continued)			
6. Wall Insulation		X	This was evaluated and found not to be cost effective.
F. Kitchen			
1. Cycle Range Hood Exhaust		X	There is no kitchen in this facility.
2. Install High Efficiency Steam Control		X	There are no steam kitchen appliances in this facility.
3. Cycle Appliances and Equipment		X	There is no kitchen in this facility.
4. Install MASU for Exhaust		X	There is no kitchen exhaust hood for this facility.
5. Exhaust Heat Reclaim		X	Exhaust air quantities are small and some are intermittent. This is not cost effective.
6. Cycle Lights in Cooler		X	There is no cooler in this facility.

FIGURE 5-1

FACILITY: Kuhn Dental Clinic — Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
F. Kitchen (Continued)			
7. Heat Pump Water Heater		X	Although there e is no kitchen, there is a water heating load. Waste heat is available to be utilized by a heat pump water heater. However, low cost of steam does not justify a heat pump water heater to meet this load.
G. Plumbing			
1. Reduce Domestic Hot Water Temperature		X	This was recommended at exit interview.
2. Repair/Maintain Steam/Hot Water Pipe Insulated		X	Insulation condition is good.
3. Install Flow Restrictors		X	Simple payback is in excess of six years.
4. Install Automatic Shutoff Faucets		X	Field survey did not indicate a need for these devices.
5. Decentralize Hot Water Heating		X	This was evaluated and found not to be cost effective.
6. Add Pipe Insulation		X	Insulation is appropriate for the systems.
H. Miscellaneous			
1. Install Heat Rec. for Incinerator		X	There is no incinerator in this facility.

FIGURE 5-1

FACILITY: Kuhn Dental Clinic

Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
H. Miscellaneous (Continued)			
2. Install Computerized EMCS		X	There is not enough energy savings potential to justify for this building alone.
3. Convert Steam Turbine to Elec. Mt.		X	There are no steam turbines in this facility.
4. Install Water Softener/Dr.		X	This applies only to the hospital complex.
5. Occupancy Sensors to Cycle Loads		X	Occupancy patterns and design of HVAC systems for this facility do not provide opportunity for savings through the use of occupancy sensors.

TABLE 5-1

FACILITY: TMC 2, 3, 4

Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A. Heating, Ventilating, and Air Conditioning			
1. Cycle On/Off Air Handler		X	The existing air handler is cycled.
2. Reduce Heating/Cooling Outside Air		X	Outside air is appropriate for the facility.
3. Reduce Recirculated Air Volume		X	Recirculated air volume is appropriate for the load.
4. Cycle On/Off Room Fan Coil Unit		X	There are no room fan coil units in these buildings.
5. Cycle Reduce Stairwell Heat		X	There are no stairwells in the building.
6. Cycle Circulating Pumps		X	Circulating pumps are cycled as appropriate.
7. Reduce Humidification to Minimum		X	There are no humidifiers in the building.
8. Reduce Condenser Water Temperature		X	The system is air-cooled condensing.
9. Cycle Fans and Pumps		X	Fans and pumps are cycled as appropriate.

TABLE 5-1

FACILITY: TMC 2, 3, 4 — Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A. Heating, Ventilating, and Air Conditioning (Continued)			
10. Reduce Water Flow Rates		X	Water flow rates are appropriate.
11. Space Temperature Reset		X	See No. 1
12. Steam Line and Trap Maintenance		X	Trap maintenance is being performed.
13. Shut Off Air to Unoccupied Area	X		Close supply to mechanical room.
14. Reset H&C Deck		X	These are DX systems.
15. Reset/Raise CHS Temperature		X	These are DX systems.
16. Load Shed		X	The building is on a load shed program from the EMCS.
17. Free Cooling with Outside Air		X	This is not appropriate. Effectively no internal load in winter.
18. Reduction of Reheat		X	There is no reheat.
19. H&C Energy Recovery		X	There is not enough waste heat available to recover and no place to use it.

TABLE 5-1

FACILITY: TMC 2, 3, 4 — Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A. Heating, Ventilating, and Air Conditioning (Continued)			
20. Reduce CHS Circulation		X	These are DX systems.
21. Reduced Motor Sizing		X	The motors are properly sized for the load.
22. Replace Manual Valves with Automatic		X	Temperature controls are automatic.
23. Install VAV Controls		X	VAV system is not feasible without providing separate heating system. Not applicable.
24. Insulate Ducts and Piping		X	Ducts and piping are appropriately insulated.
25. Eliminate Simultaneous Heating and Cooling		X	This is done by reset of decks.
26. Install NSB Controls		X	These facilities have night setback controls.
27. Clean Coils		X	Coils are clean. This is a maintenance item that should be an ongoing program.
28. Maintain Filters		X	Filters are being maintained.
29. Repair/Maintain AHU Controls		X	Air handling unit controls are operating properly.

TABLE 5-1

FACILITY: TMC 2, 3, 4

Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A. Heating, Ventilating, and Air Conditioning (Continued)			
30. Multiple/Variable Speed CT Fan Control		X	The system is a constant volume system.
31. Use Centrifugal vs Absorption Chiller		X	There are no absorption chillers in these buildings.
32. Investigate Pressure Conditions			This refers specifically to the hospital complex.
33. Investigate Revised VAV, Bldg. C		X	This refers specifically to the hospital complex.
B. Boiler Plant			
1. Boiler and Chiller Control Modifications		X	There are no boilers in thse facilities.
2. Common Manifold Chillers		X	The cooling system for these buildings is DX.
C. Lighting			
1. Turn Off Lights Not Needed		X	Field surveyrevealed that lights are on only when needed.
2. Reduce Lighting Levels		X	Lighting levels are appropriate for space functions and tasks.

TABLE 5-1

FACILITY: TMC 2, 3, 4

Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
C. Lighting (Continued)			
3. Revise Cleaning Schedule		X	Cleaning schedule does not impact energy use.
4. Convert to Energy Efficient System		X	Lighting systems are efficient.
D. Electrical			
1. Cycle Off Elevators Not Needed		X	There are no elevators in these facilities.
2. Cycle Off Pneumatic Tube System		X	There are no pneumatic tube systems in these facilities.
3. Improve Power Factor		X	Primary loads are resistive and motors are small.
4. Use Emergency Generator Peak Shave		X	There are no emergency generators in these facilities.
5. Load Shed or Cycle Electric		X	The buildings are on load shed for HVAC. Other items are small and not sheddable.
6. Balance Loads		X	Loads are balanced.
7. Reduce Transformer Loss/Load & B.		X	Transformer sizes are correct.

TABLE 5-1

FACILITY: TMC 2, 3, 4 Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
D. Electrical (Continued)			
8. Use Energy Efficient Motors		X	This was evaluated and found not to be cost effective.
9. Variable Volume Pumping		X	System is too small to obtain reasonable savings with this strategy and pump is cycled.
E. Building			
1. Reduce Infiltration		X	Simple payback is too long.
2. Install Insulated Glazing		X	Existing glazing is insulated.
3. Enclose Loading Dock		X	THere are no loading docks at these facilities.
4. Install Vestibules		X	There are vestibules at main entrance on the buildings.
5. Solar Shading		X	Inside shading devices are currently used.
6. Wall Insulation		X	Wall insulation was evaluated and found not to be cost effective.
F. Kitchen			
1. Cycle Range Hood Exhaust		X	There are no range hoods or commercial kitchens.
2. Install High Efficiency Steam Control		X	There are no steam cooking appliances.

TABLE 5-1

FACILITY: TMC 2, 3, 4 — Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
F. Kitchen (Continued)			
3. Cycle Appliances and Equipment		X	There are no kitchen appliances in these facilities.
4. Install MASU for Exhaust		X	There is no kitchen exhaust.
5. Exhaust Heat Reclaim		X	There is no exhaust from which to reclaim heat.
6. Cycle Lights in Cooler		X	There is no cooler in the building.
7. Heat Pump Water Heater		X	Water heating system is appropriate. Not a cost effective ECO for this building alone.
G. Plumbing			
1. Reduce Domestic Hot Water Temperature		X	This program was recommended at exit interview.
2. Repair/Maintain Steam/Hot Water Pipe Insulated		X	Steam and hot water pipe insulation is in good repair.
3. Install Flow Restrictors	X		This is a recommended ECO.
4. Install Automatic Shutoff Faucets		X	The field survey did not indicate that there is any savings to be gained.

TABLE 5-1

FACILITY: TMC 2, 3, 4 — Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
G. Plumbing (Continued)			
5. Decentralize Hot Water Heating		X	These buildings are so small that it would be more costly to add more heaters.
6. Add Pipe Insulation	X		Domestic Hot Water Tank
H. Miscellaneous			
1. Install Heat Rec. for Incinerator		X	There are no incinerators at these facilities.
2. Install Computerized EMCS		X	Existing.
3. Convert Steam Turbine to Elec. Mt.		X	There are no turbines in these buildings.
4. Install Water Softener/Dr.		X	There are no needs for water softening in these facilities.
5. Occupancy Sensors to Cycle Loads		X	The occupancy patterns for these facilities are not aligned and would require too much capital to revise.

TABLE 5-1

FACILITY: TMC 5 — Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A. Heating, Ventilating, and Air Conditioning			
1. Cycle On/Off Air Handler		X	This building is on EMCS and air handler is cycled.
2. Reduce Heating/Cooling Outside Air		X	Outside air is appropriate for the building occupancy.
3. Reduce Recirculated Air Volume		X	Recirculated air volume is appropriate for the heating and cooling loads.
4. Cycle On/Off Room Fan Coil Unit		X	There are no room fan coil units in this facility.
5. Cycle Reduce Stairwell Heat		X	There are no stairwells in this facility.
6. Cycle Circulating Pumps		X	Circulating pumps are cycled as appropriate.
7. Reduce Humidification to Minimum		X	There is no humidification in this facility.
8. Reduce Condenser Water Temperature		X	The system is air cooled.
9. Cycle Fans and Pumps		X	Fans and pumps are cycled as appropriate.
10. Reduce Water Flow Rates		X	Hot water flow rate is appropriate for the system.

TABLE 5-1

FACILITY: TMC 5

Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A. Heating, Ventilating, and Air Conditioning (Continued)			
11. Space Temperature Reset		X	Savings is accomplished by cycling off air handlers.
12. Steam Line and Trap Maintenance		X	The building is served by a hot water boiler; therefore, there are no steamlines.
13. Shut Off Air to Unoccupied Area		X	THis is not practical and would require total system replacement.
14. Reset H&C Deck		X	Deck temperatures are reset.
15. Reset/Raise CHS Temperature		X	This facility is served by a DX system, and there is no chilled water.
16. Load Shed		X	EMCS is capable of shedding.
17. Free Cooling with Outside Air		X	Existing dry bulb economizer
18. Reduction of Reheat		X	There is no reheat in this facility.
19. H&C Energy Recovery		X	Very little in recoverable form.
20. Reduce CHS Circulation		X	DX system; no chilled water.
21. Reduced Motor Sizing		X	Motor sizes are appropriate for the system.

TABLE 5-1

FACILITY: TMC 5 — Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A. Heating, Ventilating, and Air Conditioning (Continued)			
22. Replace Manual Valves with Automatic		X	There are no manual valves.
23. Install VAV Controls		X	The system is not convertible to VAV.
24. Insulate Ducts and Piping		X	This is done when temperature of outside air is above 60°F.
25. Eliminate Simultaneous Heating and Cooling		X	This is done when temperature of outside air is above 60°F.
26. Install NSB Controls		X	Do not recommend for this building as warmup problems could occur. Would recommend only if put on EMCS only.
27. Clean Coils		X	Existing coils were inspected and found to be clean.
28. Maintain Filters		X	Filters are maintained.
29. Repair/Maintain AHU Controls		X	Controls are operating properly.
30. Multiple/Variable Speed CT Fan Control		X	The system uses an air cooled condenser.
31. Use Centrifugal vs Absorption Chiller		X	There is no absorption chiller in this facility.

TABLE 5-1

FACILITY: TMC 5 — Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A. Heating, Ventilating, and Air Conditioning (Continued)			
32. Investigate Pressure Conditions		X	This ECO is specifically for the hospital complex only.
33. Investigate Revised VAV, Bldg. C		X	This ECO is specifically for the main hospital only.
B. Boiler Plant			
1. Boiler and Chiller Control Modifications		X	Boiler controls are okay. There is no chiller.
2. Common Manifold Chillers		X	There are no chillers in this facility.
C. Lighting			
1. Turn Off Lights Not Needed		X	Lights are switched by room and are only on when needed.
2. Reduce Lighting Levels		X	Lighting levels are appropriate for the space functions and tasks.
3. Revise Cleaning Schedule		X	Cleaning schedule does not significantly impact energy usage.
4. Convert to Energy Efficient System		X	The existing lights are energy efficient.

TABLE 5-1

FACILITY: TMC 5 Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
D. Electrical			
1. Cycle Off Elevators Not Needed		X	There are no elevators in this facility.
2. Cycle Off Pneumatic Tube System		X	There are no pneumatic tube systems in this building.
3. Improve Power Factor		X	The power factor in this building is estimated to be within acceptable limits
4. Use Emergency Generator Peak Shave		X	There is no emergency generator in this building.
5. Load Shed or Cycle Electric		X	There are no significant loads to shed or cycle.
6. Balance Loads		X	Field survey indicates that loads are balanced.
7. Reduce Transformer Loss/Load & B.		X	Transformers are appropriately sized and losses are within acceptable limits.
8. Use Energy Efficient Motors		X	This was evaluated and found not to be cost effective; however, see Note 1.
9. Variable Volume Pumping		X	System is too small to make this ECO cost effective.

TABLE 5-1

FACILITY: TMC 5 | Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
E. Building			
1. Reduce Infiltration	X		This is a recommended ECO.
2. Install Insulated Glazing		X	The amount of glazing is relatively small, making this ECO not cost effective.
3. Enclose Loading Dock		X	There is no loading dock in this building.
4. Install Vestibules		X	This building has a vestibule at the main entrance door.
5. Solar Shading		X	There are existing internal shading devices.
6. Wall Insulation		X	Building walls are provided with insulation. Additional wall insulation cannot be justified.
F. Kitchen			
1. Cycle Range Hood Exhaust		X	There is no range hood exhaust in this building.
2. Install High Efficiency Steam Control		X	There are no steam cooking appliances in this building.
3. Cycle Appliances and Equipment		X	There are no kitchen appliances and equipment.

TABLE 5-1

FACILITY: TMC 5 Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
F. Kitchen (Continued)			
4. Install MASU for Exhaust		X	There is no exhaust hood to require a makeup air unit.
5. Exhaust Heat Reclaim		X	There is no system exhaust.
6. Cycle Lights in Cooler		X	There is no cooler in this building.
7. Heat Pump Water Heater		X	Hot water heating is provided with natural gas. Replacement with electric heat pump is not cost effective; however, see Note 2.
G. Plumbing			
1. Reduce Domestic Hot Water Temperature	X		This was recommended at the exit interview.
2. Repair/Maintain Steam/Hot Water Pipe Insulated		X	Pipe insulation was in good condition at the time of the survey.
3. Install Flow Restrictors	X		This is a recommended ECO.
4. Install Automatic Shutoff Faucets		X	The field survey did not indicate that there was any savings to be gained assuming they work.

TABLE 5-1

FACILITY: TMC 5 Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
G. Plumbing (Continued)			
5. Decentralize Hot Water Heating		X	The central hot water heating system is the most cost effective for this building.
6. Add Pipe Insulation		X	The existing pipe insulation is appropriate for this facility.
H. Miscellaneous			
1. Install Heat Rec. for Incinerator		X	There is no incinerator at this building.
2. Install Computerized EMCS		X	This building is connected to the basewide EMCS system.
3. Convert Steam Turbine to Elec. Mt.		X	There is no steam turbine in this building.
4. Install Water Softener/Dr.		X	This ECO applies specifically to the main hospital building.
5. Occupancy Sensors to Cycle Loads		X	The only loads available to cycle are lights, and they are switched in each room.

TABLE 5-1

FACILITY: TMC 5 — Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION

NOTES:

1. Energy efficient motors should be used to replace any motors which require replacement as old equipment fails.

2. Heat pump water heater of equal capacity would require 8 ton compressor (96000 BTU output) at approximately $400 per ton = 3200. Waste heat available is insufficient. Gas heat would still be required in winter and possibly in summer. This ECO should be considered at the time of water heater replacement.

TABLE 5-1

FACILITY: TMC 7

Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A. Heating, Ventilating, and Air Conditioning			
1. Cycle On/Off Air Handler	X		This is a recommended ECO.
2. Reduce Heating/Cooling Outside Air		X	The outside air quantity is appropriate for the building.
3. Reduce Recirculated Air Volume		X	The recirculated air volume is as required to meet the load.
4. Cycle On/Off Room Fan Coil Unit		X	There are no room fan coil units in this building.
5. Cycle Reduce Stairwell Heat		X	There are no stairwells in this building.
6. Cycle Circulating Pumps	X		This is a recommended ECO.
7. Reduce Humidification to Minimum		X	There is no humidification in this building.
8. Reduce Condenser Water Temperature		X	There is no condenser water used in this building.
9. Cycle Fans and Pumps	X		This is a recommended ECO.
10. Reduce Water Flow Rates		X	Water flow rates are appropriate for the system being served.
11. Space Temperature Reset	X		This is a recommended ECO.

TABLE 5-1

FACILITY: TMC 7 | Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A. Heating, Ventilating, and Air Conditioning (Continued)			
12. Steam Line and Trap Maintenance	X		This is a recommended ECO.
13. Shut Off Air to Unoccupied Area		X	Fans will be cycled. There are only 2 zones on a multizone unit.
14. Reset H&C Deck		X	Hot deck reset on OA temperature.
15. Reset/Raise CHS Temperature		X	Chilled water supply temperature was 53°F at survey and is already reset.
16. Load Shed		X	The loads available to shed are too small to consider as a single project.
17. Free Cooling with Outside Air		X	Economizer control is existing on the system.
18. Reduction of Reheat		X	There is no reheat in this building.
19. H&C Energy Recovery		X	There is not enough energy to make recovery a feasible option.
20. Reduce CHS Circulation		X	The chilled water recirculated is appropriate for the system.

TABLE 5-1

FACILITY: TMC 7 Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A. Heating, Ventilating, and Air Conditioning (Continued)			
21. Reduced Motor Sizing		X	Motors are appropriately sized for the loads.
22. Replace Manual Valves with Automatic		X	There are no manual control valves in this building.
23. Install VAV Controls		X	Installation of VAV controls are not cost effective for system with 3 HP motor and 3800 cfm airflow.
24. Insulate Ducts and Piping		X	Duct and piping are insulated adequately.
25. Eliminate Simultaneous Heating and Cooling		X	Heating manually valved off during summer.
26. Install NSB Controls	X		See A1 and A9.
27. Clean Coils		X	Coils were clean at survey based on air pressure drop.
28. Maintain Filters		X	Filters are properly maintained.
29. Repair/Maintain AHU Controls		X	Controls are functioning properly.

TABLE 5-1

FACILITY: TMC 7 | Fort Campbell, Kentucky

		ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
A.		Heating, Ventilating, and Air Conditioning (Continued)			
	30.	Multiple/Variable Speed CT Fan Control		X	There is no cooling tower at this building.
	31.	Use Centrifugal vs Absorption Chiller		X	There are no chillers in this building.
	32.	Investigate Pressure Conditions		X	This ECO applies specifically to the main hospital complex.
	33.	Investigate Revised VAV, Bldg. C		X	This ECO applies specifically to the main hospital complex.
B.		Boiler Plant			
	1.	Boiler and Chiller Control Modifications		X	There are no boilers or chillers in this building.
	2.	Common Manifold Chillers		X	There are no chillers in this building.
C.		Lighting			
	1.	Turn Off Lights Not Needed		X	This is done now as discovered in our survey.
	2.	Reduce Lighting Levels		X	Lighting levels are appropriate for the tasks being performed in the building.

TABLE 5-1

FACILITY: TMC 7

Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
C. Lighting (Continued)			
3. Revise Cleaning Schedule		X	The cleaning schedule does not impact the energy use.
4. Convert to Energy Efficient System	X		This is a recommended ECO.
D. Electrical			
1. Cycle Off Elevators Not Needed		X	There are no elevators in this building.
2. Cycle Off Pneumatic Tube System		X	There is no pneumatic tube system in the building.
3. Improve Power Factor		X	The power factor in the building is within acceptable limits.
4. Use Emergency Generator Peak Shave		X	There is no emergency generator in this building.
5. Load Shed or Cycle Electric		X	There are no significant electrical loads in the building to shed.
6. Balance Loads		X	The electrical loads are balanced.

TABLE 5-1

FACILITY: TMC 7 Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
D. Electrical (Continued)			
7. Reduce Transformer Loss/Load & B.		X	Transformer losses are not significant in this building.
8. Use Energy Efficient Motors		X	The motors are small and will not run continuously. See Note 1.
9. Variable Volume Pumping		X	The piping distribution system is small and pumps will be cycled; therefore, VAV pumping will not provide significant savings.
E. Building			
1. Reduce Infiltration		X	Simple payback is too long.
2. Install Insulated Glazing		X	The glazed area of the building is small and energy savings in heating and cooling will not support replacement.
3. Enclose Loading Dock		X	There is no loading dock in this facility.
4. Install Vestibules		X	There is an existing vestibule at the main entrance. See Note 2.

TABLE 5-1

FACILITY: TMC 7 Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
E. Building (Continued)			
5. Solar Shading		X	The existing windows have both internal and external shading devices.
6. Wall Insulation		X	While wall insulation is minimum the U value is within current energy guidelines. Addition of insulation is not practical with existing construction.
F. Kitchen			
1. Cycle Range Hood Exhaust		X	There is no kitchen in this building.
2. Install High Efficiency Steam Control		X	There are no steam kitchen appliances in this building.
3. Cycle Appliances and Equipment		X	There are no kitchen appliances and equipment in this building.
4. Install MASU for Exhaust		X	There is no hood exhaust requiring makeup air supply in this building.

TABLE 5-1

FACILITY: TMC 7

Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
F. Kitchen (Continued)			
5. Exhaust Heat Reclaim		X	There is no kitchen exhaust available to reclaim heat from.
6. Cycle Lights in Cooler		X	There is no cooler in the building.
7. Heat Pump Water Heater		X	The hot water heating system is efficient and there is no waste heat available.
G. Plumbing			
1. Reduce Domestic Hot Water Temperature	X		This was recommended at the exit interview.
2. Repair/Maintain Steam/Hot Water Pipe Insulated		X	Steam and hot water pipe insulation is in good repair.
3. Install Flow Restrictors	X		This is a recommended ECO.
4. Install Automatic Shutoff Faucets		X	The survey did not indicate that energy would be saved if these were installed.
5. Decentralize Hot Water Heating		X	Decentralization is not practical for this building due to location of loads.

TABLE 5-1

FACILITY: TMC 7 | Fort Campbell, Kentucky

ENERGY CONSERVATION OPPORTUNITIES (ECO'S)	YES	NO	EXPLANATION
G. Plumbing (Continued)			
6. Add Pipe Insulation	X		Insulation is recommended for the hot water storage tank.
H. Miscellaneous			
1. Install Heat Rec. for Incinerator		X	There is no incinerator in this building.
2. Install Computerized EMCS		X	The building is too small to justify an energy monitoring and control system or connection to the basewide system as a single project.
3. Convert Steam Turbine to Elec. Mt.		X	There are no steam turbines in this building.
4. Install Water Softener/Dr.		X	This building has no need for a water softener.
5. Occupancy Sensors to Cycle Loads		X	Significant loads will be cycled by a time clock. The occupancy patterns and HVAC zoning are not compatible with the use of occupancy sensors.

5.2 ECO's Recommended

The ECO's which have been evaluated for possible implementation are listed in Table 5-2 ranked in order from highest SIR to lowest SIR, assuming #5 fuel oil as the primary fuel used at the hospital. Table 5-2A lists the evaluated ECO's ranked in order from highest SIR to lowest SIR assuming natural gas as the primary fuel used at the hospital. The ECO's which are marked with an asterisk were recommended. All those not marked were rejected.

Figure 5-1 is a graph of the annual energy saved for each dollar invested in the installed cost of the ECO. These have been sorted by ECO. The graph is shown as a scatter plot to give an idea of the range of this value for a given class or group of ECO's. There is a significant amount of correlation within certain groups of ECO's whether they are being considered for the same building or different buildings. This figure is primarily informational, but should provide the EEAP program with some relevant statistical data when installations are preparing to program ECO's into projects. It appears that the HVAC and boiler plant ECO's typically have high energy savings to investment ratios, making them more attractive than some have been in the past.

Figure 5-2 shows energy savings versus the installed cost of the ECO plotted from lowest to highest installed cost. Again, the graph is shown as a scatter plot in order to indicate statistical correlations. A statistical analysis of this data would provide some valuable information for future projects. However, this type of evaluation is outside the scope of work for this project. This data, plotted on log log scales to reduce magnitude problems, has a very linear correlation. This implies that if you wish to save more energy, you must expect to spend more money.

The ECO's were evaluated using several methods. They were evaluated on the basis of parametric runs of the BLAST program (main hospital), the BRUTE 3 program (TMC's and dental clinics), and hand calculations or combinations as necessary to determine realistic estimates of energy savings.

TABLE 5-2

SUMMARY OF ENERGY CONSERVATION OPPORTUNITIES

BLANCHFIELD ARMY COMMUNITY HOSPITAL AND AUXILIARY FACILITIES

ECO	BLDG	DESCRIPTION	INSTALLED COST	ANNUAL $ SAVINGS ENERGY	NON-ENERGY	PAYBACK (YEARS)	SIR	ENERGY SAVINGS (MBTU) ELEC	#5 OIL	NAT.GAS
* ECO-B-3a	KUHN	Repair Steam Leak	86	651	0	0.13	151.20	0.00	0.00	132.01
* ECO-B-3b	TMC-7	Repair Steam Leak	81	544	0	0.15	134.10	0.00	0.00	110.20
* ECO-A-6	TAYLOR	Time Clock for Pumps	599	1,427	0	0.42	26.31	93.40	0.00	0.00
* ECO-A-13	TMC-2	Shut-off Supply Diffuser in Mech. Rm.	26	79	0	0.33	26.13	5.18	0.00	0.00
* ECO-A-1	TMC-7	Install Time Clock	749	1,555	0	0.48	19.87	78.72	0.00	71.34
ECO-G-1	TMC-5	Reduce Domestic Water Temp.	52	41	0	1.25	15.92	0.00	0.00	8.4
* ECO-G-6b	TMC-7	Insulate Domestic Hot Water Tank	70	91	0	0.77	14.42	5.98	0.00	0.00
* ECO-G-3d	TMC-5	Install Domestic Wtr. Flow Restrictors	62	43	0	1.45	13.76	0.00	0.00	8.66
* ECO-G-3c	TAYLOR	Domestic Water Flow Restrictors	100	52	0	1.91	10.44	0.00	0.00	10.60
* ECO-G-6a	TMC-2	Insulate Domestic Water Storage Tank	49	23	0	2.20	9.10	0.00	0.00	4.57
* ECO-A-23c	TAYLOR	Economizer/VAV Controls	24,640	20,864	(476)	1.21	8.26	938.00	0.00	1,323.30
* ECO-E-1a	EPPERLY	Weatherstrip Doors & Windows	1,693	1,045	0	1.62	7.48	60.00	0.00	25.86
* ECO-B-1	BACH	Replace Exist.O2 Analyzer & Boiler Trim	55,192	23,258	0	2.37	4.86	0.00	4,062.90	0.00
* ECO-A-23b	EPPERLY	Dual Duct to VAV Boxes	16,985	7,876	(366)	2.26	4.43	358.40	0.00	486.30
* ECO-G-3b	TMC-2	Install Domestic Water Flow Restrictors	62	13	0	4.70	4.25	0.00	0.00	2.65
* ECO-C-4f	TMC-7	Revised Incand. to Fluoresc.	515	177	0	2.91	3.79	11.58	0.00	0.00
* ECO-D-8	BACH	Energy Efficient Motors	32,642	10,567	1,891	2.62	3.29	691.48	0.00	0.00
ECO-G-3e	KUHN	Domestic Water Flow Restrictors	400	66	0	6.10	3.28	0.00	0.00	13.30
* ECO-H-2	BACH	Modify & Expand Existing EMCS	582,030	191,015	(14,870)	3.30	3.07	6,139.30	16,979.20	0.00
ECO-G-3a	EPPERLY	Domestic Water Flow Restrictors	401	61	0	6.52	3.06	0.00	0.00	12.46
* ECO-A-23a	BACH	Convert Air Handlers to Variable Vol.	817,110	262,792	(18,865)	3.35	2.85	11,647.70	14,812.80	0.00
* ECO-A-22	BACH	Install Perimeter Htg. Controls	72,610	16,754	0	4.33	2.53	209.30	2,368.00	0.00
* ECO-C-4e	KUHN	Revised Incand. to Fluoresc.	6,395	1,400	0	4.57	2.42	91.61	0.00	0.00
ECO-E-1e	KUHN	Weatherstrip Doors & Windows	3,939	508	0	7.75	2.33	7.20	0.00	80.60
* ECO-C-4d	TMC-5	Revised Incand. to Fluoresc.	1,599	301	0	5.32	2.06	19.63	0.00	0.00
* ECO-C-4b	TMC-2,3,4	Revised Incand. to Fluoresc.	2,576	476	0	5.41	2.04	31.15	0.00	0.00
ECO-C-4a	EPPERLY	Revised Incand. to Fluoresc.	1,173	195	0	6.02	1.84	12.76	0.00	0.00
ECO-C-4c	TAYLOR	Revised Incand. to Fluoresc.	2,660	442	0	6.02	1.83	28.92	0.00	0.00
* ECO-D-9	BACH	Primary/Secondary (Var.Vol.)Pumping	251,280	45,225	2,342	5.28	1.60	2,959.40	0.00	0.00
ECO-A-2	BACH	Reduce O.A. to Fluorosc.,Labs & Glass Wash.	21,708	2,673	0	7.25	1.55	21.00	467.00	0.00
* ECO-B-6	BACH	Replace Existing Chillers	419,600	55,516	17,178	5.77	1.50	3,632.80	0.00	0.00
ECO-E-1b	TMC-2	Weatherstrip Doors & Windows	1,617	126	0	12.80	1.15	4.86	0.00	10.56
			2,318,701	645,856	(13,166)	3.66		27,048.37	38,689.90	2,300.81

TABLE 5-[illegible]A

SUMMARY OF ENERGY CONSERVATION OPPORTUNITIES (ASSUMING CONVERSION FROM #5 OIL TO NATURAL GAS)

BLANCHFIELD ARMY COMMUNITY HOSPITAL AND AUXILIARY FACILITIES

ECO	BLDG	DESCRIPTION	INSTALLED COST	ANNUAL $ SAVINGS ENERGY	ANNUAL $ SAVINGS NON-ENERGY	PAYBACK (YEARS)	SIR	ENERGY SAVINGS (MBTU) ELEC	ENERGY SAVINGS (MBTU) #5 OIL	ENERGY SAVINGS (MBTU) NAT.GAS
* ECO-B-3a	KUHN	Repair Steam Leak	86	651	0	0.13	151.25	0.00	0.00	132.01
* ECO-B-3b	TMC-7	Repair Steam Leak	81	544	0	0.15	134.05	0.00	0.00	110.20
* ECO-A-6	TAYLOR	Time Clock for Pumps	599	1,427	0	0.42	26.31	93.40	0.00	0.00
* ECO-A-13	TMC-2	Shut-off Supply Diffuser in Mech. Rm.	26	79	0	0.33	26.13	5.18	0.00	0.00
* ECO-A-1	TMC-7	Install Time Clock	749	1,555	0	0.48	19.87	78.72	0.00	71.34
ECO-G-1	TMC-5	Reduce Domestic Water Temp.	52	41	0	1.25	15.92	0	0	8.4
* ECO-G-6b	TMC-7	Insulate Domestic Hot Water Tank	70	91	0	0.77	14.42	5.98	0.00	0.00
* ECO-G-3d	TMC-5	Install Domestic Water Flow Restrictors	62	43	0	1.45	13.76	0.00	0.00	8.66
* ECO-G-3c	TAYLOR	Domestic Water Flow Restrictors	100	52	0	1.91	10.44	0.00	0.00	10.60
* ECO-G-6a	TMC-2	Insulate Domestic Water Storage Tank	49	23	0	2.20	9.10	0.00	0.00	4.57
* ECO-A-23c	TAYLOR	Economizer/VAV Controls	24,640	20,864	(476)	1.21	8.26	938.00	0.00	1,323.30
* ECO-E-1a	EPPERLY	Weatherstrip Doors & Windows	1,693	1,045	0	1.62	7.48	60.00	0.00	25.86
* ECO-B-1	BACH	Replace Exist.O2 Analyzer & Boiler Trim	55,192	20,047	0	2.75	4.75	0.00	0.00	4,062.90
* ECO-A-23b	EPPERLY	Dual Duct to VAV Boxes	16,985	7,876	(366)	2.26	4.43	358.40	0.00	486.30
* ECO-G-3b	TMC-2	Install Domestic Water Flow Restrictors	62	13	0	4.70	4.25	0.00	0.00	2.65
* ECO-C-4f	TMC-7	Revised Incand. to Fluoresc.	515	177	0	2.91	3.79	11.58	0.00	0.00
* ECO-H-2	BACH	Modify & Expand Existing EMCS	582,030	177,597	(14,870)	3.28	3.49	6,139.30	0.00	16,979.20
* ECO-D-8	BACH	Energy Efficient Motors	32,642	10,567	1,891	2.62	3.29	691.48	0.00	0.00
ECO-G-3e	KUHN	Domestic Water Flow Restrictors	400	66	0	6.10	3.28	0.00	0.00	13.30
* ECO-A-23a	BACH	Convert Air Handlers to Variable Vol.	817,110	251,086	(18,865)	3.25	3.24	11,647.70	0.00	14,812.80
ECO-G-3a	EPPERLY	Domestic Water Flow Restrictors	401	61	0	6.52	3.06	0.00	0.00	12.46
* ECO-A-22	BACH	Install Perimeter Heating Controls	72,610	14,882	0	4.88	2.48	209.30	0.00	2,368.00
* ECO-C-4e	KUHN	Revised Incand. to Fluoresc.	6,395	1,400	0	4.57	2.42	91.61	0.00	0.00
ECO-E-1e	KUHN	Weatherstrip Doors & Windows	3,939	508	0	7.75	2.33	7.20	0.00	80.60
* ECO-C-4d	TMC-5	Revised Incand. to Fluoresc.	1,599	300	0	5.32	2.06	19.63	0.00	0.00
* ECO-C-4b	TMC-2,3,4	Revised Incand. to Fluoresc.	2,576	476	0	5.41	2.04	31.15	0.00	0.00
* ECO-C-4a	EPPERLY	Revised Incand. to Fluoresc.	1,173	195	0	6.02	1.84	12.76	0.00	0.00
ECO-C-4c	TAYLOR	Revised Incand. to Fluoresc.	2,660	442	0	6.02	1.83	28.92	0.00	0.00
* ECO-D-9	BACH	Primary/Secondary (Var.Vol.)Pumping	251,280	45,225	2,342	5.23	1.60	2,959.40	0.00	0.00
ECO-A-2	BACH	Reduce O.A. to Fluorosc.,Labs & Glass Wash.	21,708	2,625	0	8.27	1.52	21.00	0.00	467.00
* ECO-B-6	BACH	Replace Existing Chillers	419,600	55,516	17,178	5.77	1.50	3,632.80	0.00	0.00
ECO-E-1b	TMC-2	Weatherstrip Doors & Windows	1,617	126	0	12.80	1.15	4.86	0.00	10.56
			2,318,701	615,600	(13,166)	3.85		27,048.37	0.00	40,990.71

ENERGY SAVED IN BTU'S PER DOLLAR OF INSTALLED COST

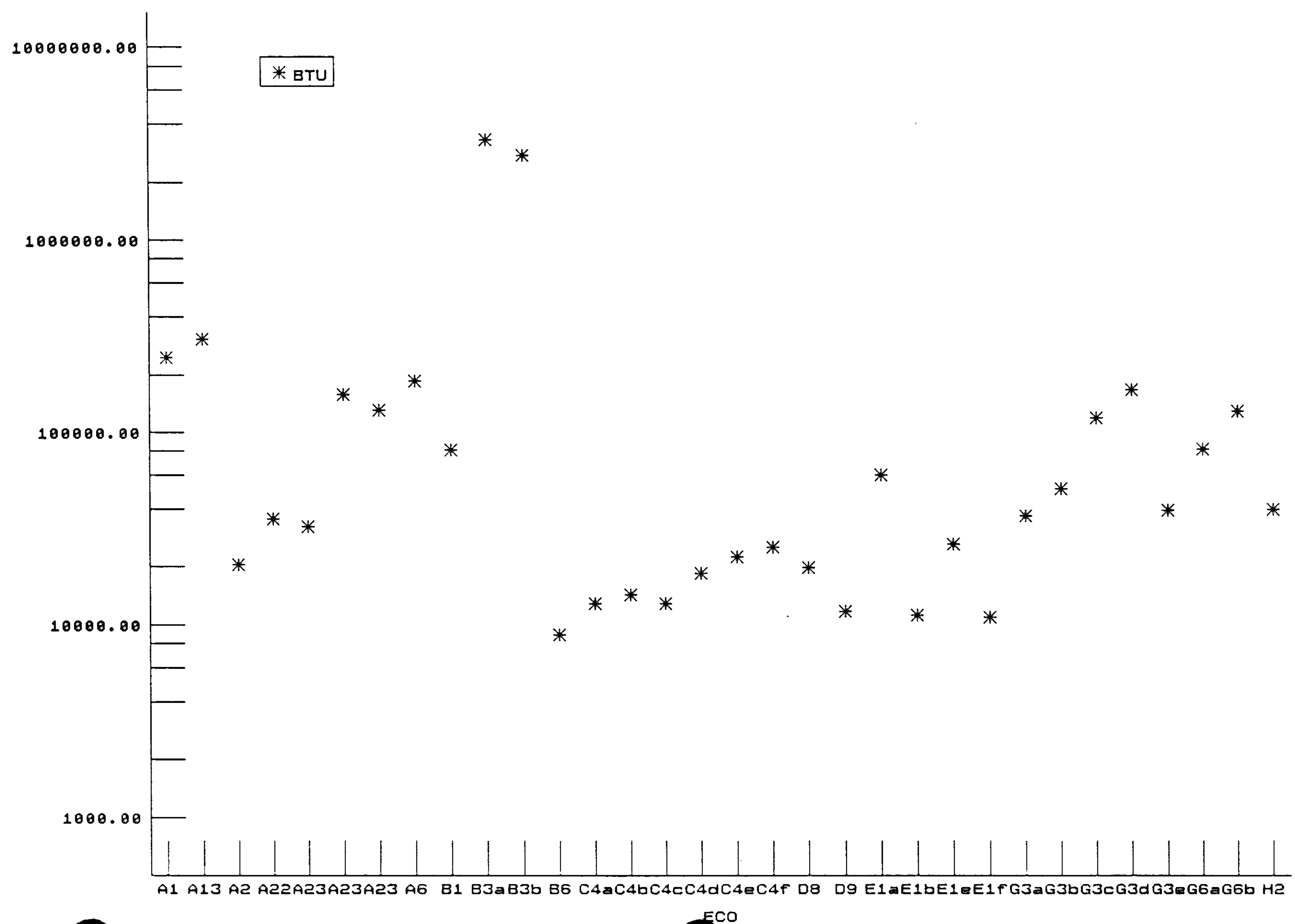


Figure 5-1

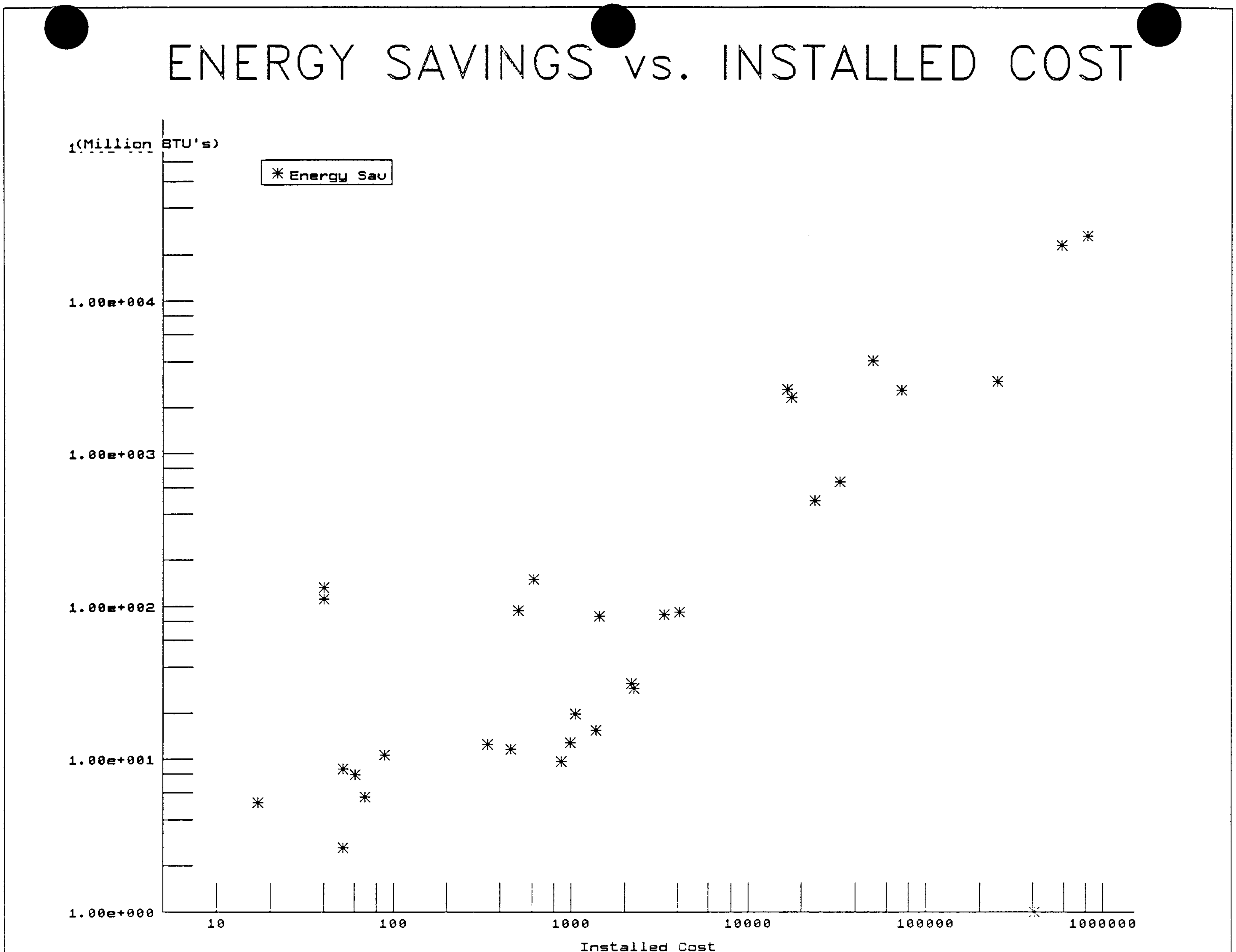

ENERGY SAVINGS vs. INSTALLED COST
1(Million BTU's)
Energy Sav
1.00e+004
1.00e+003
1.00e+002
1.00e+001
1.00e+000
10
100
1000
10000
100000
1000000
Installed Cost

Figure 5-2

5.3 ECO's Rejected

Several ECO's were evaluated which were rejected. The rejected ECO's are listed in Table 5-3. A total of 15 ECO's which were evaluated were not recommended.

TABLE 5-3 - Non-Recommended ECO's

ECO No.	ECO Description	Bldg. No.	Bldg. Name	SIR	Simple Payback
A-2	Reduce outside air quantity to selected areas	650B	Surgery, ICU, Store	1.55	7.25
C-2	Reduce lighting levels	650A,B, C,D	Hospital Complex	Not calcula-ted	Not calculated
C-4a	Change incandescent lighting to fluorescent lighting	3603	Epperly	1.84	6.03
C-4c	Enhance incandescent lighting to fluorescent lighting	5580	Taylor	1.83	6.02
C-4g	Convert to energy efficient lighting system	650A,B, C,D	Hospital Complex	0.64	17.3
D-4	Use emergency generator to peak shave	650 A,B,C	Hospital Complex	.97	3.35
E-1	Weather strip doors and windows	7166	TMC5	.14	81.3
E-1b	Weatherstrip doors and windows	6714	TMC2	1.15	12.8
E-1c	Weather strip doors and windows	5580	Taylor	.26	55.9
E-1e	Weather strip doors and windows	5980	Kuhn	2.33	7.75
E-1f	Weather strip doors and windows	3968	TMC7	.96	18.33

Table 5-3 (Continued)

ECO No.	ECO Description	Bldg. No.	Bldg. Name	SIR	Simple Payback
E-3	Enclose the loading dock	650B	Surgery, ICU, Stores	Not calculated	Not calculated
E-4	Install a vestibule at the main entrance	650B	Surgery, ICU, Stores	0.41	38.5
G-3a	Add flow restrictors to the domestic water	3603	Epperly	3.06	6.52
G-3e	Add domestic water flow restrictors	5980	Kuhn	3.28	6.1

ECO No.	Reason for Rejection
A-2	The simple payback for this ECO is very long and the SIR is very low. Although it would normally be considered as a marginally feasible project, necessary major ductwork revisions would greatly interrupt hospital operations. In this case, the engineer agrees with the hospital commander. This project should not be accepted.
C-2	Calculated lighting levels are equal to or less than Army Design Standards in almost all typical cases. In a few instances measured values were higher than design standards because of contribution from natural daylight or supplemental task lighting. Administrative controls could be considered by the facility to minimize the use of artificial light when daylighting is adequate or to restrict the use of task lighting in conjunction with fixed lighting.
C-4a	The simple payback for this ECO is very long. It is recommended that a project of this nature be performed as part of a general renovation project at such time as the building is in need of refurbishment. Future consideration should be given to this ECO.
C-4c	The simple payback for this ECO is very long. It is recommended that a project of this nature be performed as part of a general renovation project at such time as the building is in need of refurbishment. Future consideration should be given to this ECO.
C-4g	The SIR is less than 1 for this project. Refer to detailed description of calculation for reasons for not recommending this ECO. Army criteria requires the use of fluorescent fixtures. Replacement of these fixtures or ballasts are the only alternatives for use with existing energy-saver lamps.

Table 5-3 (Continued)

ECO No.	Reason for Rejection
D-4	The SIR is less than 1 for this project. Refer to detailed description of calculation for reasons for not recommending this ECO. In effect, the hospital generators would be used to offset basewide demand.
E-1	The SIR for this project is far too low to give it any serious consideration. This work could only be justified as a means of extending the useful life of the building as part of a general renovation.
E-1b	The simple payback for this project extends beyond the predicted remaining life for the building.
E-1c	The simple payback for this project is two times the predicted useful life of the building.
E-1e	The simple payback for this project is very long. The building is in need of a general renovation for refurbishment. We believe this renovation should be a major project and should include consideration of replacement of windows and doors or weather stripping.
E-1f	The simple payback for this ECO extends beyond the predicted remaining useful life of the building.
E-3	The energy and dollar savings for this ECO were so insignificant relative to the large investment required that SIR and simple payback calculations were not completed.
E-4	The SIR is less than 1 for this project. Refer to detailed description of calculation for reasons for not recommending this ECO. Although this project would add greatly to the comfort level of the facility, it does not conserve energy.
G-3a	This ECO is not recommended because the simple payback is in excess of six years. However, as existing faucets require repair or replacements they should be replaced with faucets which include flow restrictors.
G-3e	This ECO is not recommended because the simple payback is in excess of six years. This building is in need of a general renovation. It is recommended that faucets with flow restrictors be installed as existing faucets need repair or replacement or as a part of a general renovation project.

One additional ECO not listed above evaluated the possibility of replacing existing low efficiency motors with high efficiency motors. There were a few cases where this ECO was applicable and falls within the funding restrictions. Where variable speed invertors are being used to reduce motor loading under some of the projects developed, the motor efficiency and power are less of a factor.

5.4 ECIP Projects Developed

There are two ECIP projects which have been developed as a result of this study. They are described as follows:

ECIP #1

Title: Primary/Secondary (Variable Volume) Pumping

Building: 650A, 650B, 650C and 650D

Brief Description: The current design of the chilled and hot water distribution systems require that the pumps run at continuous full load delivery regardless of load. This will be corrected by installing a primary/secondary system. Variable speed drives will be added to the pumps so that they can properly match load. Low head primary pumps will be used to maintain constant flow through the chillers. Three-way valves will be replaced with two-way valves. Heating loops will be similarly revised to allow for variable flow. The variable speed drives will be installed with isolation transformers and transfer switches.

Annual Energy Savings (MBTU):	2,959.4
Annual Energy Cost Savings (Dollars):	$ 45,225
Initial Investment (Dollars):	$ 251,280
Simple Payback:	5.28 years
SIR:	1.60

ECIP #2

Title: Replace Existing Chillers

Building: 650A, 650B, 650C and 650D

Brief Description: The existing centrifugal chillers are low efficiency types that are rated at approximately .822KW/Ton at design conditions. This project replaces two of the existing chillers located in the existing central chiller plant in Building D. The new machines will have an efficiency of .602 KW/Ton with a capacity of 630 tons each.

Annual Energy Savings (MBTU): 3,632.8

Annual Energy Cost Savings (Dollars): $ 55,516

Initial Investment (Dollars): $ 419,600

Simple Payback: 5.77 years

SIR: 1.50

5.5 Other Energy Conservation Projects Developed

In addition to the two ECIP projects described under Section 5.4, there were two OSDPIF projects, one PECIP project and one QRIP project developed as a result of this analysis. These projects are described as follows:

OSDPIF #1

Title: Modify and Expand EMCS

Building: Buildings 650A, 650B, 650C and 650D

Brief Description: The new EMCS addition will be designed to supplement rather than to replace the existing EMCS and pneumatic control systems. Because of the critical nature of the hospital air handling systems, the flexibility to revert to the existing control methods is retained. The project will add temperature and humidity feedback to local distributed panels which will control the existing dual duct mixing boxes and reset deck temperatures.

Annual Energy Savings (MBTU): 23,118

Annual Energy Cost Savings (Dollars): $ 191,015

Initial Investment (Dollars): $ 582,030

Simple Payback: 3.30 years

SIR: 3.07

OSDPIF #2

Title: Convert Air Handling System to VAV

Building: 650A, 650B and 650C

Brief Description: Four existing dual duct air handling systems and two existing constant volume terminal reheat air handling systems will be converted to variable air volume systems. This will be accomplished by the modification of dual duct mixing boxes and constant volume reheat boxes with retrofit kits. Tracking dampers will be installed to maintain proper pressure relationships. New variable frequency drives and air flow controls will be provided for the air handling systems in Building C.

Annual Energy Savings (MBTU): 26,460

Annual Energy Cost Savings (Dollars): $ 262,792

Initial Investment (Dollars: $ 817,110

Simple Payback: 3.35 years

SIR: 2.85

PECIP #1

Title: Miscellaneous HVAC Modifications

Building: 650A, 650B, 650C and 650D

Brief Description: This project provides for operational improvements in three areas at Blanchfield Army Community Hospital: (1) Existing hot water perimeter heating systems are not controlled. Control valves will be added for each zoned exposure in Buildings A and B. (2) Existing oxygen analyzers and boiler trim are inoperable and will be replaced. (3) Existing electric motors serving fans, the linen transport system, and trash transport system are inefficient and will be replaced by high efficiency motors.

Annual Energy Savings (MBTU): 7,331.7

Annual Energy Cost Savings (Dollars): $ 50,579

Initial Investment (Dollars): $ 160,444

Simple Payback: 3.06 years

SIR: 3.49

QRIP #1

Title: Convert Air Handling Unit System to Variable Air Volume

Building: Epperly and Taylor Dental Clinics

Brief Description: Non-critical air handling systems in two dental clinics (Epperly and Taylor) will be converted from constant volume reheat to variable air volume. This will be accomplished by the modification of the existing boxes using retrofit kits. The supply and return fans will be provided with inlet vane dampers and static pressure and air flow controls.

Annual Energy Savings (MBTU): 3,106.0

Annual Energy Cost Savings (Dollars): $ 28,740

Initial Investment (Dollars: $ 41,625

Simple Payback: 1.49

SIR: 6.69

5.6 Operational or Policy Change Recommendations

During the performance of the survey portion of the project, as well as during the analysis phase, there have been several items of policy and operation which, with some modification, can provide a substantial amount of energy savings through the course of normal maintenance and repair. These modifications can result in energy consumption reductions basewide as well as at the medical facilities.

The first observation is a follow-up to our recommendation that domestic hot water temperature control setpoints be reduced to 105° from current operations at the time of our survey.

The second is that it should be made a matter of policy or, in the case of the hospital, a matter of contract that any motor which is being replaced, not repaired, be required to be replaced with a high power factor high efficiency motor similar to the Gould E+ motor.

Variable volume pumping can be easily achieved in some of the older constant volume (3-way control valve) hot water heating systems by either capping the bypass port on the valve or by closing the balancing valve in the bypass piping. As the valves close the hot water pumps will ride up on the pump curve toward its no flow point using considerably less energy. It is a good practice to always leave one valve open near the end of the system so the pump is never in a dead head condition. Most hot water system pumps have a flat enough curve or are installed in such small systems that the additional pressure drop across the valve is not excessive. Most control valves will accept up to 30 psig with no significant loss of performance or shortening of valve life.

5. ENERGY CONSERVATION ANALYSIS

As a rule, modifications to building envelopes, such as replacing glazing, adding insulation, etc., are rarely feasible. However, where buildings are in need of a substantial renovation or modernization, there is an opportunity to make such improvements to reduce energy consumption. Other projects which work well with major renovations are changing light fixtures to more efficient systems. Such is the case with the Kuhn Dental Clinic.

Section 9 of the final report, "Non-Programmed ECO's," contains documentation of several low-cost no-cost ECO's which can be implemented immediately.

6. ENERGY COST AND SAVINGS

6.1 Total Potential Energy and Cost Savings

The total potential energy and cost savings for the facilities included in this study as briefly discussed in the introduction are substantial. There is a potential of saving enough energy to operate a 3000 HP motor fully loaded indefinitely. Table 6-1 gives a breakdown of the potential energy and cost savings for each project developed during the study and also gives the initial investment required for each project.

Table 6-1: Total Potential Energy and Cost Savings

	MBTU ENERGY SAVINGS	TOTAL ANNUAL COST SAVINGS	INVESTMENT
ECIP 1	2,959.4	$ 47,567	$ 251,280
ECIP 2	3,632.8	72,694	419,600
OSDPIF 1	23,118.5	176,145	582,030
OSDPIF 2	26,460.5	243,927	817,110
PECIP 1	7,331.7	52,470	160,444
QRIP	3,106.0	27,898	41,625
	66,608.9	$ 620,701	$2,272,089

Figures 6-1, 6-2 and 6-3 show respectively the percentage of energy conserved, the percentage of total cost savings and the percentage of initial investment for each project.

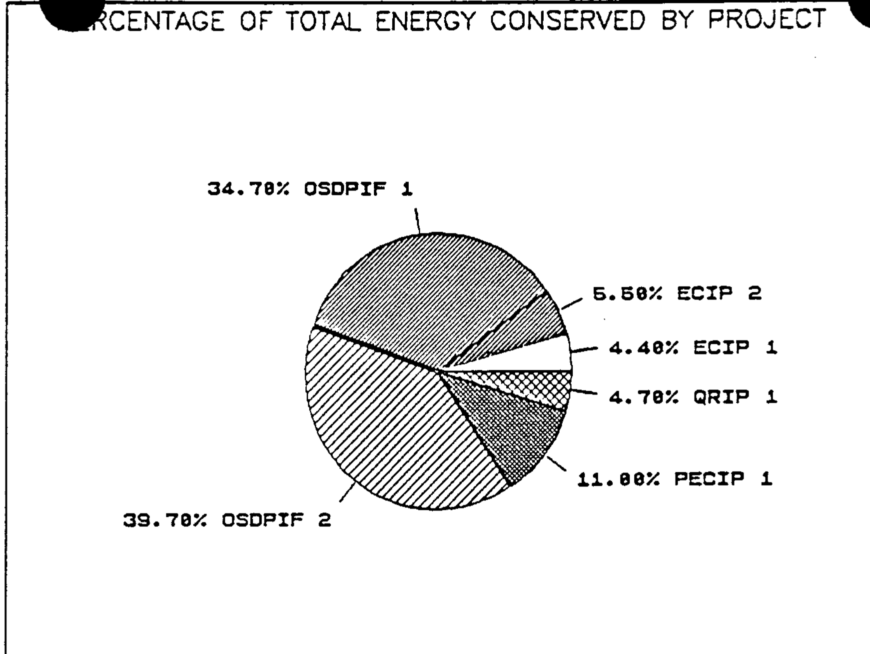


Figure 6-1

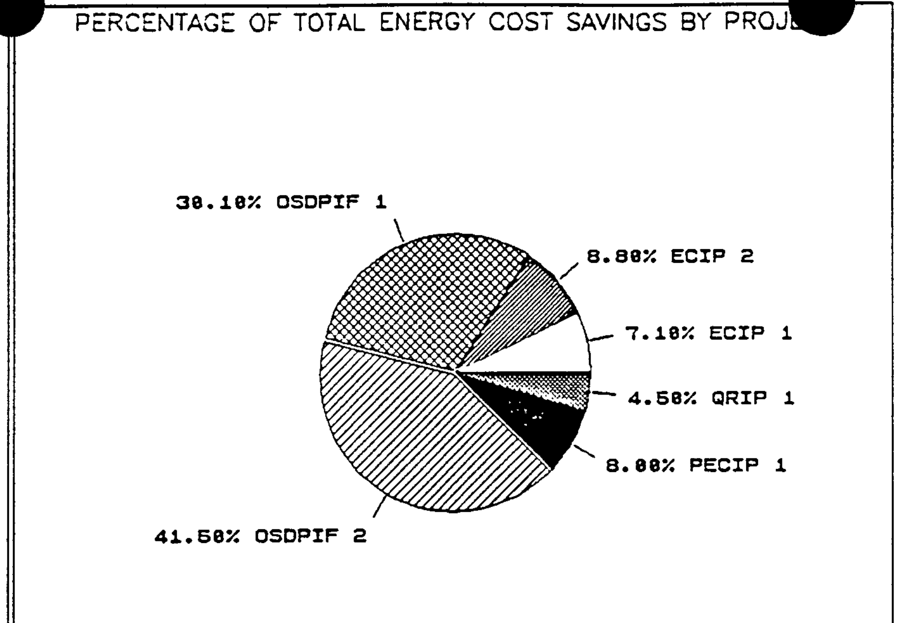


FIGURE 6-2

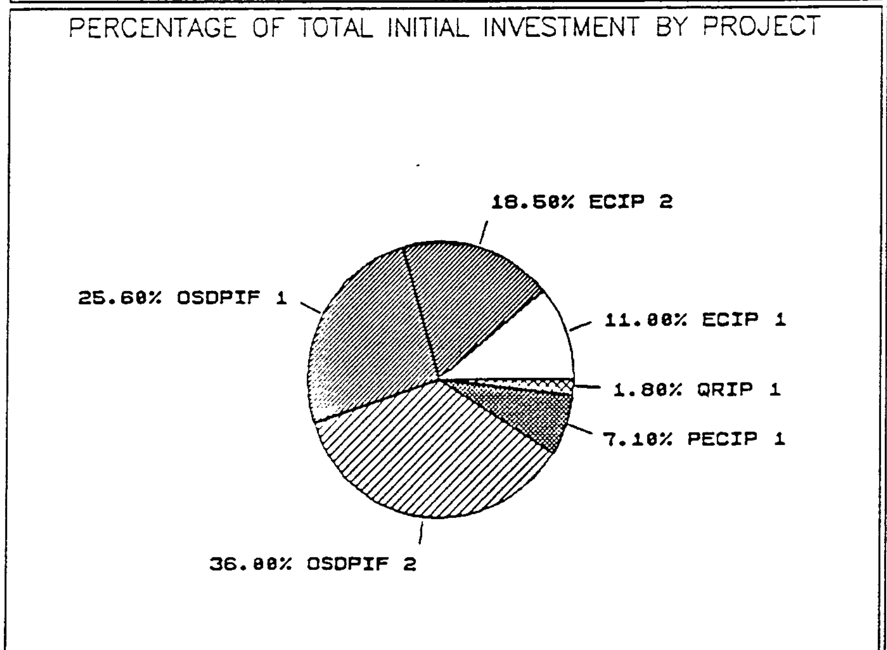


FIGURE 6-3

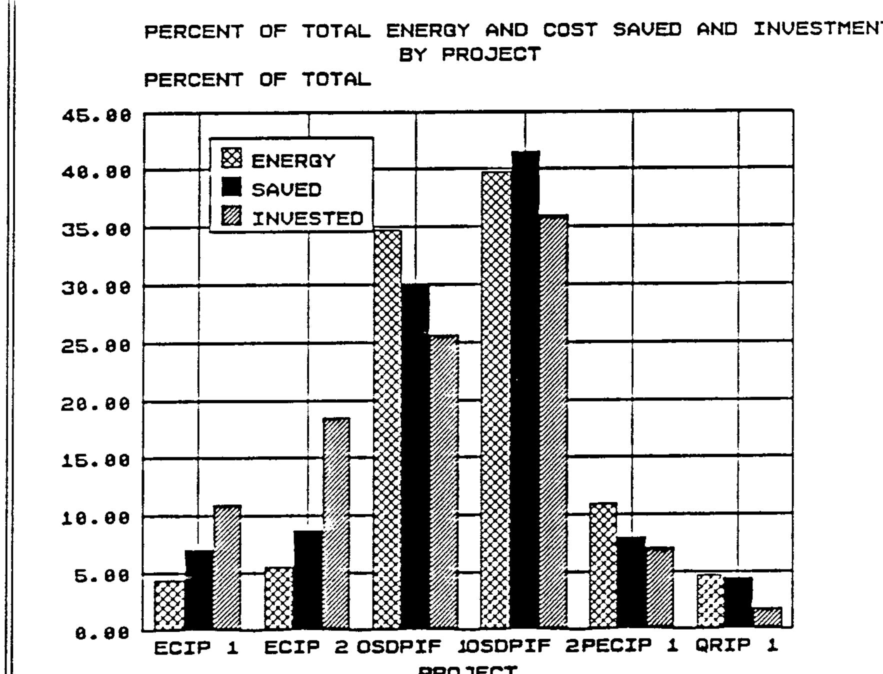


FIGURE 6-4

6.2 Percentage of Energy Conserved

There are several ways to view the percentage of total site energy conserved. Table 6-2 illustrates four possibilities. These are all that will be considered here.

Table 6-2:Percent of Energy Conserved by Project Developed by Site and Building Group

Project	Percent of Proj. Energy Conserved	Percent Hosp. Complex Energy Conserved	Percent Dent.Clinic Energy Conserved	Percent TMC's Energy Conserved
ECIP 1	1.8	2.0	0	0
ECIP 2	2.3	2.5	0	0
OSDPIF 1	14.3	15.6	0	0
OSDPIF 2	16.4	17.9	0	0
PECIP 1	4.5	5.0	0	0
QRIP	1.9	0	27.3	0
Total	41.3	42.9	27.3	0

Figure 6-5 is a graphic representation of Table 6-2.

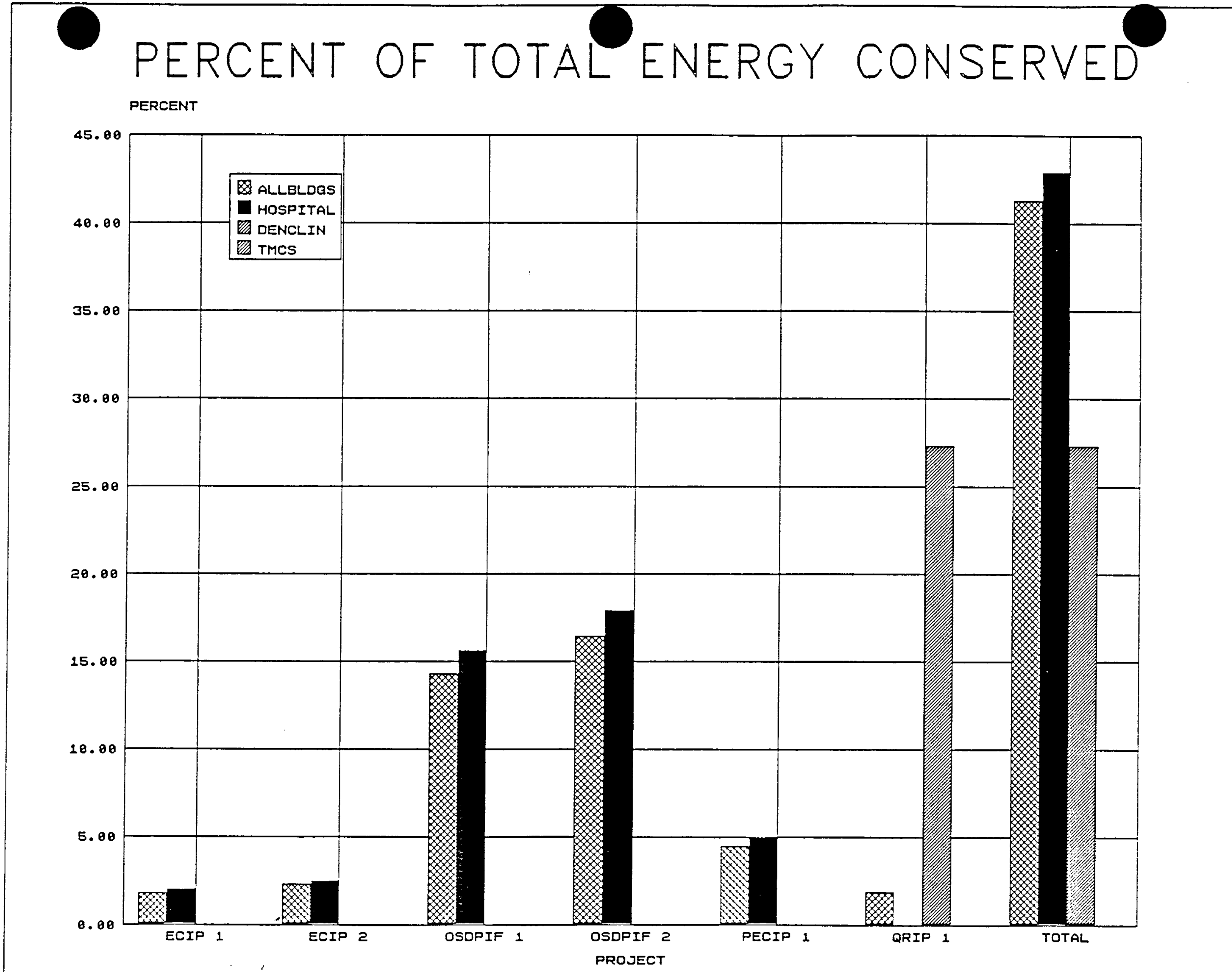

PERCENT OF TOTAL ENERGY CONSERVED
PERCENT
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
ALLBLDGS
HOSPITAL
DENCLIN
TMCS
ECIP 1
ECIP 2
OSDPIF 1
OSDPIF 2
PECIP 1
QRIP 1
TOTAL
PROJECT

FIGURE 6-5

6.3 Energy Use and Cost Before and After Projects Implemented

The energy use and costs before and after implementing the projects is represented here in terms of the group of buildings and the individual projects. Table 6-3 gives the data for energy use, and Table 6-4 gives the data for energy costs.

Table 6-3: Energy Consumption Before and After Project Implementation

Project	All Bldgs	Hospital	Dental Clinics	TMC's
Present	161,324.8	147,986.5	11,370.2	1,968.1
Post ECIP 1	158,365.4	145,027.1	11,370.2	1,968.1
Post ECIP 2	154,732.6	141,394.3	11,370.2	1,968.1
Post OSDPIF1	131,614.1	118,275.8	11,370.2	1,968.1
Post OSDPIF2	105,153.6	91,815.3	11,370.2	1,968.1
Post PECIP 1	97,821.9	84,483.6	11,370.2	1,968.1
Post QRIP 1	94,715.9	84,483.6	8,264.2	1,968.1

Table 6-4: Energy Costs Before and After Project Implementation

Project	All Bldgs.	Hospital	Dental Clinics	TMC's
Present	1,526,619	1,398,328	107,493	20,798
Post ECIP 1	1,481,394	1,353,103	107,493	20,798
Post ECIP 2	1,425,878	1,279,587	107,493	20,798
Post OSDPIF1	1,234,863	1,106,572	107,493	20,798
Post OSDPIF2	972,071	843,780	107,493	20,798
Post PECIP 1	921,492	793,201	107,493	20,798
Post QRIP 1	892,752	793,201	78,753	20,798

Figures 6-6 and 6-7 are progressive graphs of the energy consumption and energy costs, respectively, before and after each project implementation.

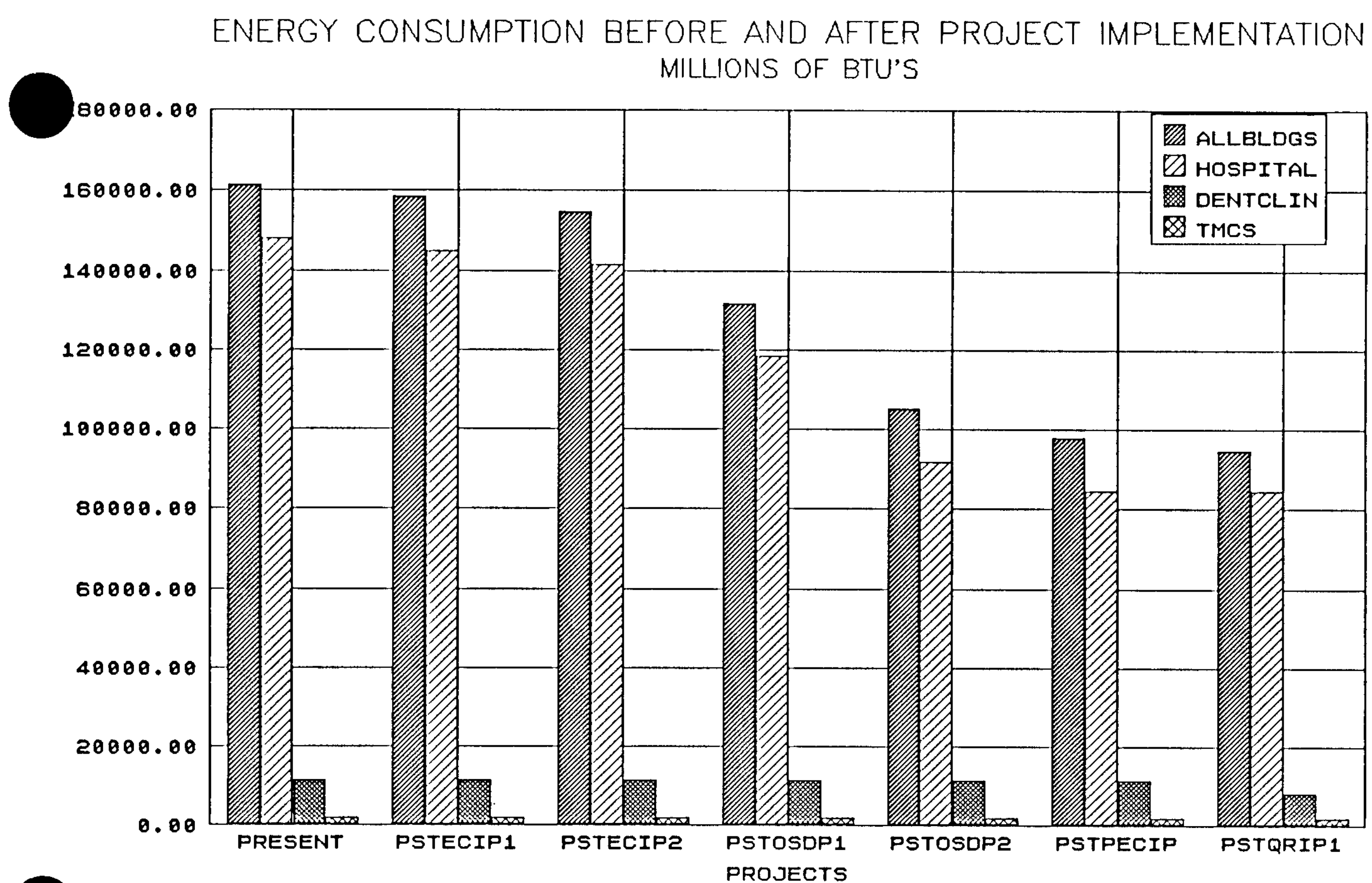


FIGURE 6-6

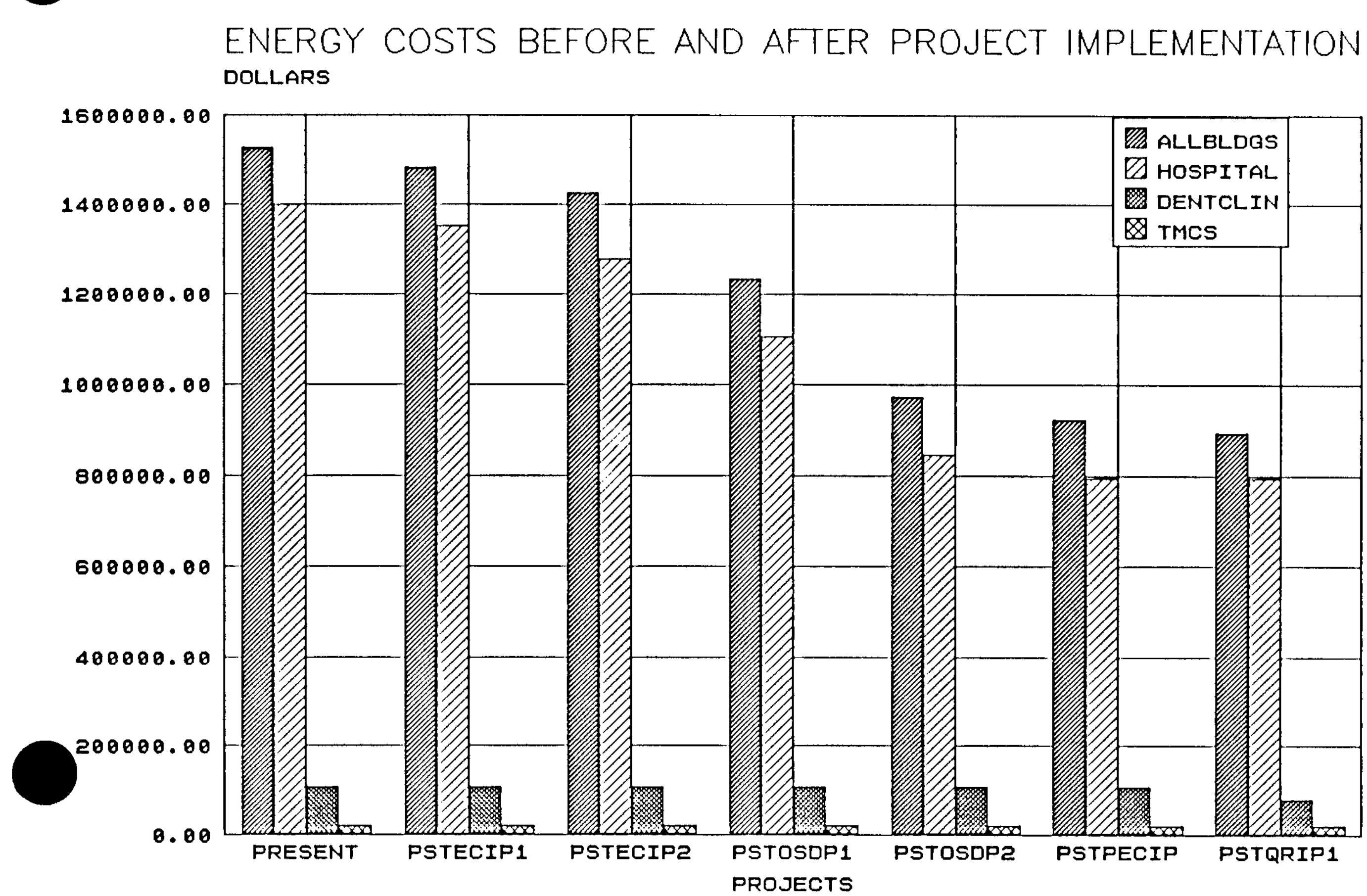


FIGURE 6-7

7. ENERGY PLAN

7.1 Project Breakouts with Total Costs and SIR

Refer to Table 7-1 for project breakouts with total costs, SIR's, simple payback and energy savings.

Table 7-1: Project Breakouts with SIR's

PROJECT	INSTALLED COST	ANNUAL $ SAVINGS ENERGY	NON-ENERGY	SIMPLE PAYBACK YEARS	SIR	ELEC MBTU	ENERGY SAVINGS #5 OIL MBTU	NATURAL GAS	TOTAL
ECIP #1	251,280	45,225	2,342	5.28	1.60	2,959.4	0.0	0.0	2,959.40
ECIP #2	419,600	55,516	17,178	5.77	1.50	3,632.8	0.0	0.0	3,632.80
OSDPIF #1	582,030	191,015	(14,870)	3.3	3.07	6,139.3	16,979.2	0.0	23,118.50
OSDPIF #2	817,110	262,792	(18,865)	3.35	2.85	11,647.7	14,812.8	0.0	26,460.50
PECIP #1	160,444	50,579	1,891	3.06	3.49	900.8	6,430.9	0.0	7,331.70
QRIP #1	41,625	28,740	(842)	1.49	6.69	1,296.4	0.0	1,809.6	3,106.00

TABLE 7-2

SUMMARY OF RECOMMENDED LOW COST/NO COST PROJECTS (PAYBACK LESS THAN 1 YEAR)

BLANCHFIELD ARMY COMMUNITY HOSPITAL AND AUXILIARY FACILITIES

	ECO	BLDG	DESCRIPTION	INSTALLED COST	ANNUAL $ SAVINGS ENERGY	ANNUAL $ SAVINGS NON-ENERGY	PAYBACK (YEARS)	SIR	ENERGY SAVINGS (MBTU) ELEC	ENERGY SAVINGS (MBTU) #5 OIL	ENERGY SAVINGS (MBTU) NAT.GAS	REPORT LOCATION
*	ECO-B-3a	KUHN	Repair Steam Leak	86	651	0	0.13	151.20	0.00	0.00	132.01	9-17
*	ECO-B-3b	TMC-7	Repair Steam Leak	81	544	0	0.15	134.10	0.00	0.00	110.20	9-22
*	ECO-A-6	TAYLOR	Time Clock for Pumps	599	1,427	0	0.42	26.31	93.40	0.00	0.00	9-7
*	ECO-A-13	TMC-2	Shut-off Supply Diffuser in Mech. Rm.	26	79	0	0.33	26.13	5.18	0.00	0.00	9-12
*	ECO-A-1	TMC-7	Install Time Clock	749	1,555	0	0.48	19.87	78.72	0.00	71.34	9-2
*	ECO-G-6b	TMC-7	Insulate Domestic Hot Water Tank	70	91	0	0.77	14.42	5.98	0.00	0.00	9-27
				1,611	4,347	0	0.37		183.28	0.00	313.55	

TABLE 7-3

SUMMARY OF NONPROGRAMED ECO'S HAVING SIR>1.0 & PAYBACK < 10 YEARS

BLANCHFIELD ARMY COMMUNITY HOSPITAL AND AUXILIARY FACILITIES

ECO	BLDG	DESCRIPTION	INSTALLED COST	ANNUAL $ SAVINGS ENERGY	NON-ENERGY	PAYBACK (YEARS)	SIR	ENERGY SAVINGS (MBTU) ELEC	#5 OIL	NAT.GAS	REPORT LOCATION
ECO-G-1	TMC-5	Reduce Domestic Water Temp.	52	41	0	1.25	15.92	0.00	0.00	8.4	9-60
* ECO-G-3d	TMC-5	Install Domestic Wtr. Flow Restrictors	62	43	0	1.45	13.76	0.00	0.00	8.66	9-75
* ECO-G-3c	TAYLOR	Domestic Water Flow Restrictors	100	52	0	1.91	10.44	0.00	0.00	10.60	9-70
* ECO-G-6a	TMC-2	Insulate Domestic Water Storage Tank	49	23	0	2.20	9.10	0.00	0.00	4.57	9-81
* ECO-E-1a	EPPERLY	Weatherstrip Doors & Windows	1,693	1,045	0	1.62	7.48	60.00	0.00	25.86	9-55
* ECO-G-3b	TMC-2	Install Domestic Water Flow Restrictors	62	13	0	4.70	4.25	0.00	0.00	2.65	9-65
* ECO-C-4f	TMC-7	Revised Incand. to Fluoresc.	515	177	0	2.91	3.79	11.58	0.00	0.00	9-50
ECO-G-3e	KUHN	Domestic Water Flow Restrictors	400	66	0	6.10	3.28	0.00	0.00	13.30	9-150
ECO-G-3a	EPPERLY	Domestic Water Flow Restrictors	401	61	0	6.52	3.06	0.00	0.00	12.46	9-144
* ECO-C-4e	KUHN	Revised Incand. to Fluoresc.	6,395	1,400	0	4.57	2.42	91.61	0.00	0.00	9-45
ECO-E-1e	KUHN	Weatherstrip Doors & Windows	3,939	508	0	7.75	2.33	7.20	0.00	80.60	9-134
* ECO-C-4d	TMC-5	Revised Incand. to Fluoresc.	1,599	301	0	5.32	2.06	19.63	0.00	0.00	9-40
* ECO-C-4b	TMC-2,3,4	Revised Incand. to Fluoresc.	2,576	476	0	5.41	2.04	31.15	0.00	0.00	9-34
ECO-C-4a	EPPERLY	Revised Incand. to Fluoresc.	1,173	195	0	6.02	1.84	12.76	0.00	0.00	9-107
ECO-C-4c	TAYLOR	Revised Incand. to Fluoresc.	2,660	442	0	6.02	1.83	28.92	0.00	0.00	9-112
ECO-A-2	BACH	Reduce O.A. to Fluorosc.,Labs & Glass Wash.	21,708	2,673	0	7.25	1.55	21.00	467.00	0.00	9-97
			43,384	7,516	0	5.77		283.85	467.00	167.10	

7. ENERGY PLAN

7.2 Schedule of Energy Conservation Project Implementation

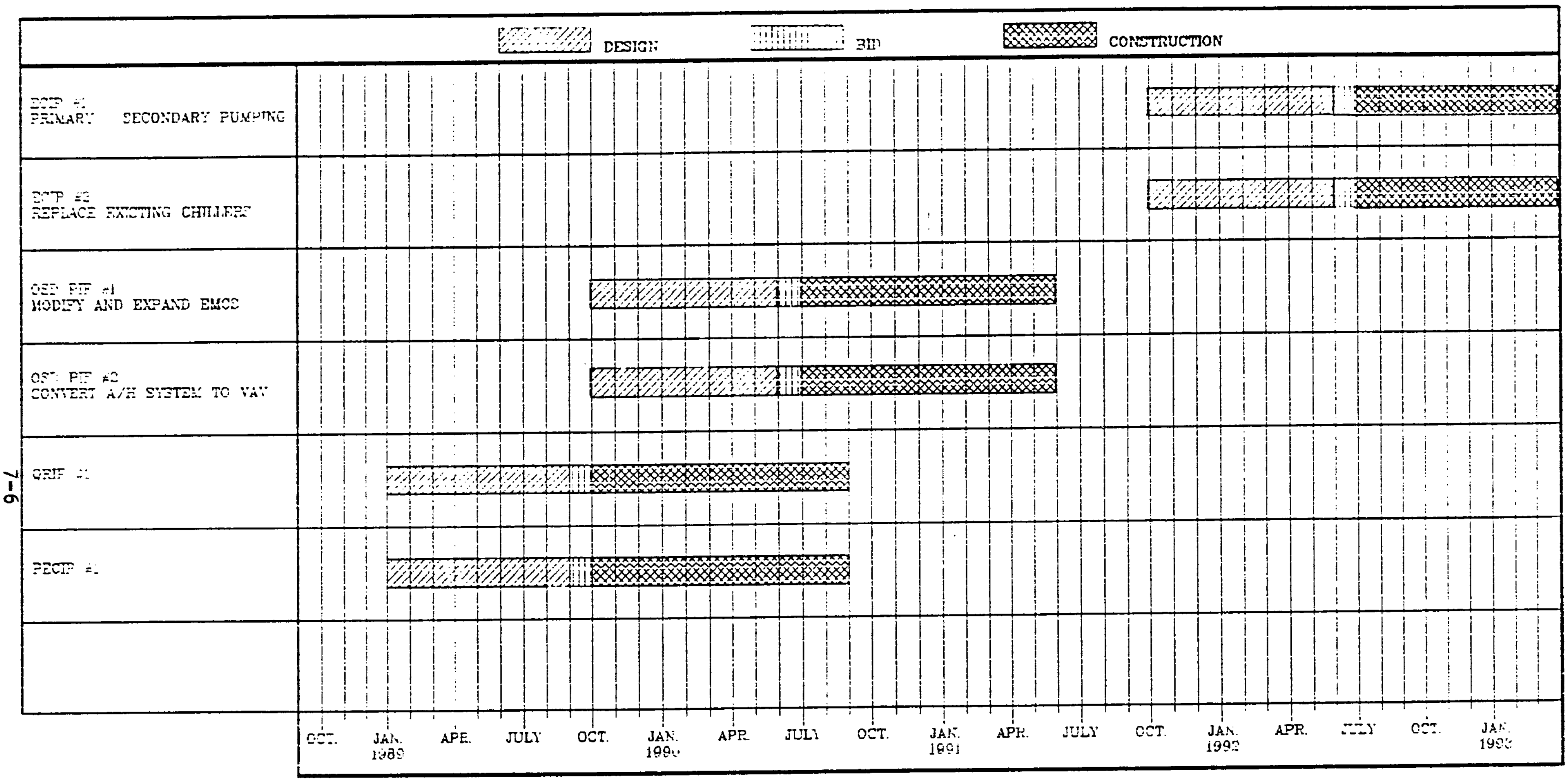


FIGURE 7-1
SCHEDULE OF ENERGY CONSERVATION PROJECT IMPLEMENTATION